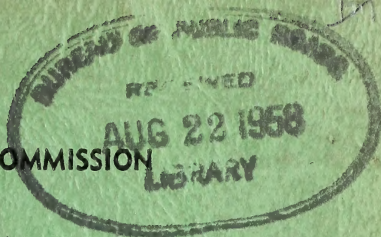


S  
625.7042  
H3SSR  
1958



STATE HIGHWAY COMMISSION

of

MONTANA

Helena, Montana

**Standard**  
**Specifications**  
for  
**Road and Bridge**  
**Construction**

38



1958 Edition

20

Montana State Library



3 0864 1003 5359 1

PROPERTY  
OF  
BUREAU OF PUBLIC ROADS  
LIBRARY



*Book No.* \_\_\_\_\_

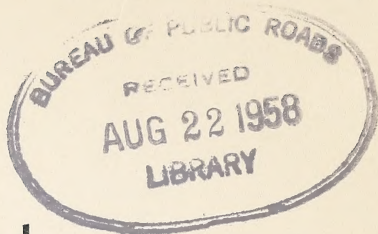
PR-770a

GPO

16-31629-3



TE  
5062  
M9M9  
1958



# Standard Specifications for Road and Bridge Construction.

As Amended January 1, 1958

✓  
1958 Edition

Adopted by the  
STATE HIGHWAY COMMISSION,  
2 of  
MONTANA  
///

As of January 1, 1958

WITHDRAWN

BOOK

851



WILSON

## STATE OF MONTANA

J. Hugo Aronson, Governor

### STATE HIGHWAY COMMISSION

Harry L. Burns.....	Chairman
L. V. Swanson.....	Vice Chairman
Roy L. Sorrells.....	Member
Otis S. Waters.....	Member
S. N. Halvorson.....	Member

### STATE HIGHWAY ENGINEER

Fred Quinnell, Jr.

### HEADQUARTERS

Sixth and Roberts Avenues

Helena, Montana





Digitized by the Internet Archive  
in 2014

# STANDARD SPECIFICATIONS

## TABLE OF CONTENTS

		Titles	Page
<b>Explanation of Reference and Numbering System.....</b>			<b>1</b>
GENERAL PROVISIONS			
Section	1	Definitions and Terms.....	3
Section	2	Proposed Requirements and Conditions .....	13
Section	3	Award and Execution of Contract....	19
Section	4	Scope of Work.....	21
Section	5	Control of the Work.....	27
Section	6	Control of Materials.....	33
Section	7	Legal Relations and Responsibility..	39
Section	8	Prosecution and Progress.....	51
Section	9	Measurement and Payment.....	63
SPECIFICATIONS			
Section	10	Clearance of Right of Way.....	69
Subsection	10.00	Clearing .....	70
Subsection	10.10	Grubbing .....	72
Subsection	10.20	Clearing and Grubbing.....	73
Subsection	10.30	Roadside Cleanup .....	74
Section	11	Excavation and Embankment.....	77
Subsection	11.00	Roadway, Drainage and Borrow Excavation .....	78
Subsection	11.50	Special Borrow .....	81
Subsection	11.60	Excavation for Culverts and Retaining Walls .....	82
Subsection	11.70	Disposal of Surplus Material.....	83
Subsection	11.80	Embankment .....	83
Section	12	Overhaul .....	89
Section	13	Haul .....	91
Section	14	Rolling .....	95
Section	15	Watering .....	101
Section	16	Contingent Construction and Operations .....	105
Subsection	16.00	Equipment Use .....	106
Subsection	16.10	Existing Surface Preparation.....	107
Subsection	16.20	Existing Surface Removal.....	107
Subsection	16.30	Traffic Provisions .....	110
Subsection	16.40	Obliteration of Old Roadway.....	114

		<b>Titles</b>	<b>Page</b>
Section	17	Erosion Control .....	115
Subsection	17.00	Topsoil .....	116
Subsection	17.10	Seeding .....	117
Subsection	17.20	Mulching .....	119
Section	18	Unassigned.....	
Section	19	Unassigned.....	
Section	20	Aggregate Surfacing—General Conditions .....	121
Section	21	Various Surfacing Types.....	129
Section	22	Surface Stabilization .....	133
Subsection	22.10	Aggregate Admixture .....	134
Subsection	22.30	Soil Cement Stabilization.....	135
Section	23	Selected Borrow Base Course.....	143
Section	24	Crushed Base Course.....	147
Section	25	Crushed Top Surfacing.....	151
Section	26	Binder or Filler.....	155
Section	27	Crushed Cover Aggregate.....	159
Section	28	Stockpiled Surfacing Aggregate.....	163
Section	29	Unassigned.....	
Section	30	Bituminous Materials .....	167
Section	31	Contiguous with Section 30.....	
Section	32	Bituminous Prime or Tack Coat.....	181
Section	33	Bituminous Surface Treatment.....	185
Section	34	Bituminous Surfacing—Road Mix....	193
Section	35	Bituminous Surfacing—Plant Mix..	201
Section	36	Bituminous Seal Coat.....	215
Section	37	Unassigned.....	
Section	38	Unassigned.....	
Section	39	Portland Cement Concrete Pavement .....	221
Section	40	Removal of Structures and Facilities .....	243
Subsection	40.00	Removal of Existing Structures....	244
Subsection	40.20	Removal of Miscellaneous Facilities .....	245
Section	41	Concrete Bridges .....	247
Section	42	Steel Bridges .....	251



		<b>Titles</b>	<b>Page</b>
Section	43	Timber Structures .....	271
Section	44	Box Culverts and Retaining Walls..	277
Section	45	Excavation for Structures.....	279
Section	46	Concrete .....	285
Subsection	46.00	Portland Cement Concrete.....	286
Subsection	46.10	Class "F" Concrete.....	315
Section	47	Reinforcing Steel .....	317
Section	48	Structural Steel .....	321
Section	49	Bearing and Expansion Plates.....	325
Section	50	Rockers and Bearing Plates.....	327
Section	51	Treated and Untreated Timber.....	329
Section	52	Piling .....	335
Section	53	Railing and Miscellaneous Structure Items .....	347
Section	54	Paints for Wood and Metal.....	351
Section	55	Unassigned.....	
Section	56	Unassigned.....	
Section	57	Riprap .....	355
Section	58	Rubble Masonry .....	361
Section	59	Hand-Laid Rock Embankment.....	365
Section	60	Pipe Culverts .....	367
Section	61	Removal and Relay of Pipe Culverts .....	375
Section	62	Aggregate Backfill for Pipe Culverts .....	379
Section	63	Corrugated Metal Pipe—Circular and Elliptical .....	381
Section	64	Corrugated Metal Pipe—Arches.....	387
Section	65	Structural Plate Elliptical Pipe Culverts .....	391
Section	66	Structural Plate Arch Culverts and Stockpasses .....	395
Section	67	Unassigned.....	
Section	68	Reinforced Concrete Pipe.....	401
Section	69	Reinforced Concrete Arches and Underpasses .....	407
Section	70	Underdrains and Sewer Tile.....	409
Section	71	Ditch Lining and Flume.....	413
Section	72	Bituminous Treated Pipe Culverts..	417

		<b>Titles</b>	<b>Page</b>
Section	73	Unassigned.....	
Section	74	Curbs, Gutters, Sidewalks, Headwalls, Etc. ....	423
Subsection	74.00	Curbs and Gutter.....	424
Subsection	74.50	Concrete Sidewalk .....	426
Subsection	74.60	Concrete Headwalls, Headgates and Supports .....	427
Section	75	Manholes, Inlets, Catch Basins, Etc.	429
Section	76	Unassigned.....	
Section	77	Unassigned.....	
Section	78	Unassigned.....	
Section	79	Fence and Fencing.....	431
Subsection	79.10	Wire Fence .....	432
Subsection	79.40	Stock Guards .....	441
Subsection	79.60	Chain Link Fence.....	443
Section	80	Unassigned.....	
Section	81	Unassigned.....	
Section	82	Unassigned.....	
Section	83	Unassigned.....	
Section	84	Unassigned.....	
Section	85	Unassigned.....	
Section	86	Unassigned.....	
Section	87	Unassigned.....	
Section	88	Signs and Signing.....	451
Subsection	88.00	Railroad Crossing Protective Signs .....	452
Section	89	Unassigned.....	
Section	90	Guard Rail and Guide Posts.....	453
Section	91	Unassigned.....	
Section	92	Unassigned.....	
Section	93	Markers and Monuments.....	459
Section	94	Remove and Reset Facilities.....	461
Section	95	Adjustment of Existing Structures	463
Section	96	Unassigned.....	
Section	97	Miscellaneous Items .....	467
Section	98	Public Utility Moves and Preliminary Costs .....	469
Section	99	Non-Participating Stockpiles .....	471

## EXPLANATION OF REFERENCE AND NUMBERING SYSTEM

**SECTION.** This Book of Specifications is divided into sections for functional purposes. The first nine Sections are General Provisions. The following Sections are construction and material Specifications, or are used for accounting and administrative purposes. Section numbers occur in the index, at the beginning of each Section and on each page of each Section. Samples are 2, 9, 15, 22, etc. Section numbers run consecutively from beginning to end of the book.

**SUBSECTION.** Several sections, following Section 9, will be divided into subsections for reference purposes and for clarification. Subsection numbers are composed of four digits with a decimal point separating the pairs—e.g. 10.00, 20.00, 30.00. The subsection numbers are a continuation of the section number—e.g. Section 30, Subsections 30.10, 30.20, 30.30, etc.

**ARTICLE.** Each section and subsection is divided into articles. See Section 4, Article 04.01, 04.02, etc. See Section 10, Subsection 10.10, GRUBBING, Article 10.11, DESCRIPTION: Article 10.12, CONSTRUCTION METHODS: Article 10.13, METHOD OF MEASUREMENT. The word "Article" is not written into the text in the belief that reference will be easier by number only. The first two digits of an article number always conform to the section number.

**PARAGRAPH.** Many, but not all, articles will be subdivided into paragraphs—e.g. 10.12(a), 10.12(b), etc. A "Paragraph," in these specifications, may be composed of two or more paragraphs as defined grammatically. For example, see Paragraph (b), "Placing," Article 20.05, Section 20. Paragraph (b) is composed of 6 grammatical paragraphs but in these specifications shall be called a "Paragraph."

**ITEM.** Item numbers, where used, occur at the end of a section. The item number is composed of four digits and is a continuation of the section number—e.g. Section 26, Items 2610, 2612, 2615, 2640. Every proposal for work under these specifications will contain a list of items of work, such as listed below:

Item Number	Item Description
1101	Unclassified Excavation and Borrow
1203	Overhaul
6515	15" Reinforced Concrete Pipe Culvert
6905	Relay Pipe Culverts

The specification concerning each item will be found, quite readily, by looking in this book for section numbers corresponding to the first two digits of the item number. For example, the specification for "Overhaul" will be found under Section 12; 15" Concrete Pipe Culvert, under Section 65.







**SECTION 1**

**DEFINITIONS AND TERMS**



## STANDARD SPECIFICATIONS

Whenever, in these specifications and/or other contract documents, the following terms, or pronouns in place of them, are used, the intent and meaning shall be interpreted as set forth in the following definitions.

### 01.01 ABBREVIATIONS

- A.A.N.—American Association of Nurserymen
- A.A.R.—Association of American Railroads
- A.A.S.H.O.—American Association of State Highway Officials
- A.I.A.—American Institute of Architects
- A.I.S.C.—American Institute of Steel Construction
- A.I.S.I.—American Iron and Steel Institute
- A.R.A.—American Railway Association
- A.R.E.A.—American Railway Engineering Association
- A.S.A.—American Standards Association
- A.S.C.E.—American Society of Civil Engineers
- A.S.L.A.—American Society of Landscape Architects
- A.S.T.M.—American Society for Testing Materials
- A.W.P.I.—American Wood Preservers Institute
- A.W.W.A.—American Water Works Association
- A.W.S.—American Welding Society
- B.P.R.—Bureau of Public Roads, Department of Commerce.
- C.R.S.I.—Concrete Reinforcing Steel Institute
- S.A.E.—Society of Automotive Engineers
- W.C.L.A.—West Coast Lumbermen's Association
- W.C.L.B.—West Coast Bureau of Lumber Grades and Inspection
- W.P.A.—Western Pine Association

**01.02 ACCESS CONNECTION.** Any roadway facility by means of which vehicles can enter or leave an arterial highway. This includes intersections at grade, private driveways and ramps or separate lanes connecting with cross streets or frontage roads.

**01.03 ADVERTISEMENT.** The advertisement for proposal for all work or materials on which bids are to be accepted.

**01.04 ARTERIAL HIGHWAY.** A general term denoting a highway designed primarily for through traffic, usually on a continuous route.

**01.05 AUXILIARY LANE.** The portion of the roadway, adjoining the traveled way, designed for parking, speed-change, or for other purposes supplementary to movement of through traffic.

**01.06 AWARD.** The decision of the Commission to accept the proposal of the lowest responsible bidder for the work, subject to the execution and approval of a satisfactory contract therefor and bond to secure the performance thereof, and to such other conditions as may be specified or otherwise required by law.



**01.07 BELT HIGHWAY.** An arterial highway for carrying traffic, partially or entirely, around an urban area or portion thereof. (Also called circumferential highway.)

**01.08 BIDDER.** Any individual, firm, partnership, joint-venture, or corporation submitting a proposal for the work contemplated, acting directly or through a duly authorized representative.

**01.09 BRIDGE.** A structure which provides a waterway, or other opening, and which has a clear span of over 20 feet, measured along its centerline, between the inside faces of abutments, or a multiple span structure of which the sum of the individual clear span plus the aggregate width of the intermediate supports is in excess of 20 feet.

**01.10 CALENDAR DAY.** Every day shown on the calendar, Sundays and holidays included.

**01.11 CHANGE ORDER.** A written order to the contractor, signed by the Engineer, ordering a change in the work as illustrated or described by the plans and specifications. If the work is of a nature involving an adjustment of unit price, a supplemental agreement shall be executed. Change orders duly signed and executed by the contractor constitute authorized modifications of the contract.

**01.12 COMMISSION.** The State Highway Commission of Montana as established by legislation.

**01.13 CONTRACT.** The executed written agreement between the Commission and the successful bidder, covering the performance of the work and the furnishing of labor and materials, by which the contractor is bound to perform the work and furnish the labor and materials, and by which the Commission is obligated to compensate him therefor at the mutually established and accepted rate or price.

The contract shall include the notice to contractors, proposal, contract and contract bond, the standard specifications, contained in this book, supplemental specifications, special provisions, general and detailed plans, standard drawings and notice to proceed; also any written change orders and agreements that are required to complete the construction of the work in an acceptable manner, including authorized extensions thereof, all of which constitute one instrument.

**01.14 CONTRACT BOND.** The approved form of security furnished by the contractor and his surety as a guaranty of good faith on the part of the contractor to execute the work in accordance with the terms of the contract.

**01.15 CONTRACT PERIOD.** The period of time (a) from the specified date of commencing work to the date computed by using the specified number of calendar days, or (b) from the stipulated date of commencing work to the specified date of completion. Inclusive dates shall be used, in either case.

**01.16 CONTRACT ITEM (PAY ITEM).** An item of work specifically described and for which a price, either unit or lump sum, is provided. It includes the performance of all work and the furnishing of all labor, equipment and materials, described in the text of a specification item included in the contract or described in any subdivision of the text of the supplemental specifications or special provisions of the contract. The first two digits of a contract item number (the number preceding the item description in the proposal) correspond to a section number in these specifications. Thus any interested person, having a book of specifications, can readily look up the specifications for any contract item.

**01.17 CONTRACTOR.** Party of the second part to the contract, acting directly or through his agents or employees.

**01.18 CONTRACT TIME OR COMPLETION DATE.** The number of calendar days shown in the proposal indicating the time allowed for the completion of the work contemplated in the contract.

In case a calendar date of completion is shown in the proposal, in lieu of the number of calendar days, such work contemplated shall be completed by that date.

**01.19 CONTROL OF ACCESS.** The condition where the right of owners or occupants of abutting land or other persons to access, light, air or view in connection with a highway is fully or partially controlled by public authority.

**01.20 CULVERT.** Any structure not classified as a bridge, which provides an opening under any roadways.

**01.21 DEPARTMENT (HIGHWAY).** The functional organization acting for and on behalf of the State Highway Commission.

**01.22 DIVIDED HIGHWAY.** A highway with separated roadways for traffic in opposite directions.

**01.23 EMPLOYEE.** Any person working on the project mentioned in the contract, of which these specifications are a part, and who is under the direction or control, or receives compensation from the contractor or subcontractor.

**01.24 ENGINEER.** The State Highway Engineer, acting directly or through an assistant or other duly authorized representative of the State Highway Commission, such assistant or representative acting within the scope of the particular duties assigned to him or of the authority given him.

**01.25 EQUIPMENT.** All machinery and equipment, together with the necessary supplies for upkeep and maintenance, including tools and apparatus necessary for the proper construction and acceptable completion of the work.

**01.26 EXTRA WORK.** Additional construction items which are not included in the original contract.

**01.27 EXTRA WORK ORDER.** A special form of change order concerning the performance of work or furnishing of materials involving extra work not included in the contract. Such extra work may be performed at agreed prices or on a force account basis as provided elsewhere in these specifications.

**01.28 FRONTAGE STREET OR ROAD.** A local street or road auxiliary to and located on the side of an arterial highway for service to abutting property and adjacent areas and for control of access.

**01.29 HIGHWAY.** A general term denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way.

**01.30 HIGHWAY SEPARATION.** Any structure carrying highway traffic over or under another highway or street.

**01.31 INSPECTOR.** An authorized representative of the Engineer, assigned to make any or all necessary inspections of the work performed and materials furnished by the contractor.

**01.32 INSTRUCTION TO BIDDERS.** Form prepared and furnished by the department, for the information of bidders submitting proposals. It specifies the provisions, requirements and instructions pertaining to the method, manner and time of submitting bids and approximate quantities of materials required.

**01.33 INVITATION FOR BIDS.** The advertisement for proposals for all work or materials on which bids are required. Such advertisement will indicate, with reasonable accuracy, the quantity and location of the work to be done or the character and quantity of the material to be furnished and the time and place of the opening of proposals.

**01.34 LABORATORY.** The main testing laboratory of the commission, located at Helena, or other laboratories of the commission located at other points throughout the state, or any other laboratory which may be designated by the engineer to make tests of materials and of work involved in the contract.

**01.35 MAJOR ITEM.** Any item having an original contract value in excess of ten (10) percent of the total original contract amount shall be classed as a major item.

**01.36 MATERIALS.** Any substances specified for use in the construction of the project and its appurtenances.

**01.37 MEDIAN.** The portion of a divided highway separating the traveled ways for traffic in opposite directions.

**01.38 MEDIAN LANE.** A speed-change lane within the median to accommodate left-turning vehicles.

**01.39 NOTICE TO PROCEED.** A written notice to the contractor of the date on which he shall begin the prosecution of the work.

**01.40 NOTICE OF AWARD.** A written notice to the contractor notifying him of the acceptance of his proposal and the contract award.

**01.41 PLANS.** The official approved plans, profiles, typical cross sections, working drawings and supplemental drawings, or exact reproduction thereof, which show the location, character, dimensions, and details of the work to be done, and which are to be considered as part of the contract supplementary to these specifications and which are identified in the proposal. The word "Plans" shall be interpreted to include "Standard Drawings" when referring to documents included in a contract.

**01.42 PREQUALIFICATION.** The approved form, or forms, upon which the contractor shall furnish the information as to his ability to perform the work, his experience in similar work, the equipment owned, and his financial condition as related to his ability to finance the work.

**01.43 PROJECT.** The specific section of the highway together with all appurtenances and construction to be performed thereon under the contract.

**01.44 PROPOSAL.** The offer of the bidder, submitted on the prescribed proposal form, to perform the work and to furnish the labor and materials at the prices quoted by the bidder.

**01.45 PROPOSAL FORM.** The approved prepared form on which the bidder is to submit, or has submitted, his proposal for the work contemplated.

**01.46 PROPOSAL GUARANTY.** The security, designated in the proposal, to be furnished by the bidder as a guaranty of good faith to enter into a contract with the state, if the work of constructing the improvement is awarded to him.

**01.47 RAILWAY-HIGHWAY SEPARATION.** Any structure carrying highway traffic over or under the tracks of any railway.

**01.48 RIGHT-OF-WAY.** The land secured and reserved to the public for highway purposes.

**01.49 ROADBED.** The graded portion of a highway, usually considered as the area between the intersections of top and side slopes, upon which the base course, surface course, shoulders and median are constructed.

**01.50 ROADSIDE.** A general term denoting the area adjoining the outer edge of the roadway. Extensive areas between the roadways of a divided highway may also be considered



roadside. Roadside improvement may include work on the cut and fill slopes as well as the areas outside of the roadway section.

**01.51 ROADWAY.** The portion of the highway within limits of construction.

**01.52 SHOULDER.** That portion of the roadway, contiguous with the traveled way, constructed for the accommodation of stopped vehicles, for emergency use and for lateral support of base and surface courses.

**01.53 SPECIAL PROVISIONS.** Special directions, provisions or requirements, peculiar to the project under consideration and not otherwise thoroughly or satisfactorily detailed or set forth in the specifications. Special provisions shall prevail over specifications and supplemental specifications, whenever in conflict therewith, and over all plans. They set forth the final contractual intent as to the matter involved.

**01.54 SPECIFICATIONS.** The general term comprising all the directions, provisions and requirements contained in this Book of Standard Specifications, together with such as may be added or adopted as supplemental specifications or special provisions, all of which are necessary for the proper performance of the contract.

**01.55 SPEED-CHANGE LANE.** An auxiliary lane, including tapered areas, primarily for the acceleration or deceleration of vehicles entering or leaving the through traffic lane.

**01.56 STANDARD DRAWINGS.** These are special drawings and sketches, including detailed instructions, where necessary, issued and made available by the engineer to the contractor and other interested persons. They will pertain to certain items of work contained in a contract.

**01.57 STATE.** The State of Montana acting through its authorized representative.

**01.58 STREET.** A general term denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way, within cities, towns or villages.

**01.59 SUBCONTRACTOR.** The individual, firm or corporation undertaking the execution of a part of the work under the terms of the contract by virtue of an agreement between himself and the contractor, subject to the approval of the engineer.

**01.60 SUBBASE.** Materials placed immediately above the subgrade to provide required stability.

**01.61 SUBGRADE.** The portion of the roadbed prepared as a foundation for the subbase, base and surface courses.



**01.62 SUBSTRUCTURE.** All of that part of a structure below the bridge seats or below the springing lines of arches. Backwalls and parapets of abutments, and wingwalls, shall be considered as parts of the substructure.

**01.63 SUPERINTENDENT.** The executive representative of the contractor who is authorized to receive and fulfill instructions from the engineer and who shall supervise and direct the construction work.

**01.64 SUPERSTRUCTURE.** All that part of the structure above the bridge seats or above the springing lines of arches, including the flooring.

**01.65 SUPPLEMENTAL AGREEMENT.** A written agreement executed by the contractor and engineer covering changes or alterations in plans and specifications, and supplementing the original contract.

**01.66 SUPPLEMENTAL SPECIFICATIONS.** Specifications adopted subsequent to the publication of this Book of Standard Specifications. They generally involve new construction items or substantial changes in the approved specifications. Supplemental specifications shall prevail over the standard specifications whenever in conflict therewith.

**01.67 SURETY.** The corporate body bound with and for the contractor, for the full and complete performance of the contract, and for the payment of all debts pertaining to the work. When applying to the "Proposal Guaranty" it refers to the corporate body which engages to be responsible in the execution by the bidder of the contract documents.

**01.68 SURFACING.** Any material superimposed on the sub-base or base for its consolidation but functioning primarily as a support for vehicular traffic.

**01.69 TRAFFIC LANE.** The portion of a traveled way designed for the movement of a single line of vehicles.

**01.70 TRAVELED WAY.** The portion of the roadway, exclusive of shoulders and auxiliary lanes, designed for the movement of vehicles.

**01.71 WORK.** "Work" shall be understood to mean the furnishing of all labor, materials, equipment, and other incidentals necessary or convenient to the successful completion of the project and the carrying out of all the duties and obligations imposed by the contract.

**01.72 WORKING DAY.** A calendar day, exclusive of Sundays and state recognized legal holidays, on which weather and other conditions not under the control of the contractor will permit construction operations to proceed for the major part of the day on the principal item or items of work which would normally be in progress at that time.

**01.73 WORKING DRAWINGS.** Stress sheets, shop drawings, erection plans, false-work plans, framework plans, cofferdam plans, bending diagrams for reinforcing steel, or any other supplementary plans or similar data which the contractor is required to submit to the engineer for approval.

**01.74 WORK ORDER.** A written order signed by the engineer, of a contractual status requiring performance by the contractor without negotiation of any sort.

**01.75** In order to avoid cumbersome and confusing repetition of expressions in these specifications, whenever it is provided that anything is, or is to be, or to be done, if or as, or when, or where "contemplated," "required," "directed," "specified," "considered necessary," "deemed necessary," "permitted," "suspended," "approved," "acceptable," "unacceptable," "suitable," "unsuitable," "satisfactory," "unsatisfactory," or "sufficient," it shall be understood as if the expression were followed by the words "by or to the engineer with the approval of the commission."

**01.76** Wherever in these specifications appear references such as the following examples: 1. "Equipment (a)," "Aggregate Surfacing," it shall be understood to have been prefixed with and specifically mean, (of the Paragraph (a) of the specifications section "Aggregate Surfacing") and/or example: 2. "shall conform to the requirements of "Concrete," shall have been prefixed with and mean (of the specification section "Concrete"), etc. This form is adopted for purposes of simplicity and elimination of needless repetition.

**01.77** It shall be understood thoroughly by all concerned that all things contained herein, together with the "Advertisement for Proposals" or "Notice to Contractors," "Special Provisions," and the "Contract Bond," as well as any papers attached to or bound with any of the above, also any and all supplemental agreements made or to be made, are hereby made a part of these specifications and contract, and are to be considered one instrument.





## SECTION 2

# PROPOSAL REQUIREMENTS AND CONDITIONS



**02.01 CONTENTS OF PROPOSAL.** The bidder will be furnished with a proposal which will state the location and description of the contemplated work, and which will show the approximate estimate of the various quantities of the work to be performed and the materials to be furnished, the amount of "Proposal Guaranty" (which must accompany the proposal) and the date and time of the opening of proposals. It will also state any special provisions or requirements which vary from or are not contained in the standard specifications. All papers bound with or attached to the proposal are a necessary part thereof and must not be detached.

**02.02 INTERPRETATION OF ESTIMATE.** The quantities scheduled in the proposal are to be considered as approximate and as prepared for the comparison of bids only. The unit prices to be tendered by the bidder are to be tendered expressly for the scheduled quantities as they may be increased or decreased within the restricting percentage hereinafter stipulated. Payment to the contractor will be made for the actual quantities only of work performed or materials furnished in accordance with the contract, and it is understood that the scheduled quantities of work to be done and materials to be furnished may each be increased or diminished as hereinafter provided without in any way invalidating the bid prices.

**02.03 EXAMINATION OF PLANS, SPECIFICATIONS, SPECIAL PROVISIONS AND SITE OF WORK.** The bidder is required to examine carefully the site of, and the proposal, plans, specifications and contract, for the work contemplated. It will be assumed that the bidder has made said examination and is satisfied as to the conditions to be encountered in performing the work as scheduled or as at any time altered without resulting in increases or decreases of more than the restricting percentage hereinafter stipulated, and to the character, quality and quantities of work to be performed and materials to be furnished, including increases and decreases, and as to the requirements of these specifications, special provisions and contract. It is mutually agreed that submission of a proposal shall be considered prima facie evidence that the bidder has made such examination and is satisfied as to all the conditions and contingencies.

**02.04 PREPARATION OF PROPOSAL.** The bidder must submit his proposal on the form furnished by the Commission. The blank spaces in the form must be filled in correctly for each and every item for which a quantity is given, and the bidder must state the prices (written both in words and numerals) for which he proposed or proposes to do each item of work contemplated. All proposals must be extended and totaled, and it is understood that, in cases of errors or discrepancies in extension, the unit prices written in words shall be held as governing.



When an item in the proposal contains a choice to be made by the bidder, the bidder shall indicate his choice in accordance with the specifications for that particular item, and thereafter no further choice will be permitted.

The bidder must sign his proposal correctly, showing his name and post office address. If the proposal is submitted by a firm or partnership, the name and post office address of each member of the firm or partnership must be shown; if submitted by a corporation, the name of the State under the laws of which the corporation was chartered, and the names, titles and business addresses of the President and Secretary must appear.

**02.05 REJECTION OF PROPOSALS CONTAINING IRREGULARITIES.** Proposals may be considered irregular and may be rejected for the following reasons:

(a) If the proposal furnished is not used or is altered.

(b) If there are unauthorized additions, conditional or alternate bids, or irregularities of any kind which may tend to make the proposal incomplete, indefinite or ambiguous as to its meaning.

(c) If the proposals for two or more projects, advertised separately, are connected, or made contingent one upon the other, in such manner that the proposal for any particular project shall carry a provisional deduction in the bid price on one or more of the other projects.

(d) If the bidder adds any provisions reserving the right to accept or reject an award or to enter into a contract pursuant to an award.

(e) If the unit prices contained in the bid schedule are obviously unbalanced either in excess or below the reasonable cost analysis value.

(f) If they fail to contain a unit price for every pay item indicated, except in the case of authorized alternate pay items.

**02.06 PROPOSAL GUARANTY.** No proposal will be considered unless accompanied by a proposal guaranty, in an amount of at least five (5) percent of the bid, made unconditionally payable to the State Highway Commission of Montana, which at the bidder's option may be cash, postal money order, cashier's check, certified check, bank money order, or bid bond.

If a bid bond is used it must be countersigned by a Montana resident agent. Alteration of the proposal form as required to provide for the form of guaranty elected shall be allowed.

**02.07 DELIVERY OF PROPOSALS.** Each proposal must be submitted in a special envelope furnished by the Commission. The blank spaces on the envelope must be filled in correctly so as to indicate its contents clearly. If forwarded by mail, the above-mentioned envelope may be enclosed in an-

other, addressed to the State Highway Commission at Helena, Montana; if forwarded otherwise than by mail it shall be delivered at the office of the State Highway Commission in Helena, Montana. Proposals will be received until the time stipulated in the advertisement for the opening thereof.

Any bid which arrives by mail after the time fixed for opening, but before award is made, and it is shown to the satisfaction of the Commission authorized to make the award that the non-arrival on time was due solely to delay in the mails for which the bidder was not responsible, such bid will be received and considered. No responsibility will attach to the Commission for the premature opening of a bid not properly addressed and identified. Unless specifically authorized, telegraphic bids will not be considered, but modifications by telegraph of bids already submitted will be considered if received prior to the hour set for opening.

**02.08 WITHDRAWAL OF PROPOSALS.** Bidders may withdraw any proposal after it has been deposited with the Commission, provided the bidder makes his request to the Commission prior to the time of opening the proposals on the particular project; and at the time of the opening of the proposals, when such proposal is reached, it will be returned to the bidder unopened and unread.

**02.09 PUBLIC OPENING OF PROPOSALS.** Proposals will be opened publicly and read at the time and on the date set in the "Advertisement for Proposals" or "Notice to Contractor," by the Commission in Helena, or at such other place as may be designated in the proposal or notice to contractors. Bidders or their authorized agents are invited to be present.

**02.10 DISQUALIFICATION OF BIDDERS.** More than one proposal from an individual, a firm or partnership, a corporation or an association under the same or different names will not be considered. If it shall be found that any bidder is interested in more than one proposal for the work contemplated the Commission will cause the rejection of all proposals in which such bidder is interested. Any or all proposals will be rejected if there is reason for believing that collusion exists among the bidders and all participants in such collusion will not be considered in future proposals for the same work.

**02.11 CONDITIONAL BIDS.** A bidder who desires to bid upon more than one project at a single letting but who desires to protect himself against receiving the award of more projects than he is equipped to handle may bid upon any number of projects, securing the protection desired by making the following written statement signed by the bidder and attached to the proposal for each of the projects bid on:

"This bid is conditional upon my (or our) receiving the award for only (insert number of projects) of the project bid upon at this letting. If the contract for any other project, or projects, up to the number herein specified, is awarded to me (us), then this bid shall be considered withdrawn."

In case a bidder who has conditioned his bid, as above provided, is low bidder on several projects, it shall be optional with the Commission as to which of the projects is awarded him.

**02.12 COMPETENCY OF BIDDERS.** No contract will be awarded except to responsible bidders capable of performing the class of work contemplated. Each bidder shall submit, on a standard form furnished by the Commission, a certified statement of qualifications. This statement will remain in effect for one (1) year, starting from the date entered for the "Condition at close of business." This statement shall be current during the period of time in which the bidder proposes to submit a bid. The preparation and submission of all prequalification statements shall conform to current regulations of the Commission.

The certified statement will be considered an essential part of the bid and failure to submit the statement prior to the time specified by the commission may be deemed sufficient cause for rejection of the bid without reading it.

**02.13 MATERIAL GUARANTY.** Before any contract is awarded the bidder may be required to furnish a complete statement of the origin, composition, and manufacture of any or all materials to be used in the construction of the improvement, together with samples which may be subjected to the tests provided for in these specifications to determine their quality and fitness for the work.





## SECTION 3

# AWARD AND EXECUTION OF CONTRACT





**03.01 CONSIDERATION OF BIDS.** The comparison of bids will be based on the correct extension and summation of all items included in the proposal at prices bid. The commission reserves the right to reject any or all proposals, or to waive technicalities, as may be deemed best for the interest of the State.

**03.02 AWARD OF CONTRACT.** All contracts will be awarded by the Commission to the lowest responsible bidder, within forty-five (45) days from the date of the opening of the proposals; provided, however, that should no award be made within forty-five (45) days, all proposals will be rejected.

**03.03 RETURN OF PROPOSAL GUARANTY.** All "Proposal Guaranties" except those of the three (3) lowest bidders will be returned within three (3) days following the date of opening bids. Should no award be made within forty-five (45) days, all proposals will be rejected and all guaranties returned.

**03.04 CONTRACT BOND REQUIRED.** The successful bidder, at the time of the execution of the contract, must deposit with the Commission a surety bond for the full amount of the contract. The form of bond shall be that provided by the Commission and the surety shall be acceptable to the Commission. The surety bond must be executed by a surety company authorized by law to transact such business in the State of Montana.

**03.05 EXECUTION OF CONTRACT.** The individual, firm, or corporation to whom or to which the contract has been awarded shall enter into a contract with the Commission within ten (10) days after receipt of the contract documents. No proposal shall be considered binding upon the Commission until the execution of the contract.

**03.06 APPROVAL OF CONTRACT AND BOND.** The contract shall be subject to the approval of the Attorney General of Montana, after execution by the contractor and by the Chairman of the Commission. The bond shall likewise be approved after execution by the contractor and surety.

**03.07 FAILURE TO EXECUTE CONTRACT.** Failure to execute the contract or give satisfactory security, as specified, shall be just cause for annulment of the award, or of the contract, if executed, and in the event of such annulment of the award, or of the contract, the proposal guaranty shall be forfeited to the State, not as a penalty, but as liquidated damages. Award may then be made to the next lowest responsible bidder or the work may be readvertised and constructed under contract, or otherwise, as the Commission decides.



## SECTION 4

### SCOPE OF WORK



**04.01 INTENT OF PLANS AND SPECIFICATIONS.** The contractor shall do all clearing and grubbing, make all excavations and embankments, do all shaping and surfacing, construct all ditches, drainage structures, bridges, and other appertaining structures, as indicated in the proposal and on the plans; remove obstructions from within the lines of the highway and shall do such additional, extra and incidental work as may be considered necessary to complete the roadway to the proper lines, grades and cross sections, in a substantial and workmanlike manner. He shall furnish, unless otherwise provided, all implements, machinery, equipment, tools, material and labor necessary to the prosecution of the work. In short, the contractor shall construct the improvement in strict accordance with the plans, specifications, supplemental specifications, special provisions and contract, and when completed, shall leave it in a neat and finished condition. It shall be understood that the work to be done shall not necessarily be limited to within the highway boundaries.

**04.02 SPECIAL WORK.** Should any construction or conditions which are not covered by the standard specifications or supplemental specifications be anticipated on any proposed work "Special Provisions" for such work will be made a part of the proposal and shall be considered a part of the standard specifications or supplemental specifications the same as though contained fully therein. Should any such special provisions or requirements conflict with the aforesaid specifications, the "Special Provisions" shall govern.

**04.03 INCREASED OR DECREASED QUANTITIES.** The engineer reserves the right to make such alterations in the plans or in the quantities of work as may be considered necessary. Such alterations shall be in writing and shall not be considered as a waiver of any conditions of the contract nor to invalidate any of the provisions thereof, provided that no alteration shall involve an extension or shortening of the length of the project of more than twenty-five (25) percent, and provided that a supplemental agreement with the contractor will be necessary when alterations involve (1) an increase or decrease of more than twenty-five (25) percent of the total cost of the work calculated from the original proposal quantities and the contract unit prices, or (2) an increase of more than twenty-five (25) percent in the quantity of any one major contract item, including earth or common roadway excavation but not including excavation of any other class nor items of foundation piling. Alterations involving an increase of more than twenty-five (25) percent in the quantity of any one minor contract item will not require a supplemental agreement. Before work shall be started on any alteration requiring such supplemental agreement, the agreement setting forth an equitable adjustment of compensation shall be executed by the engineer and the contractor. The contractor shall perform the work as increased or decreased and no allowance shall be made for anticipated profits or loss due to such changes.

**04.04 EXTRA WORK.** The contractor shall perform extra work, for which there is no quantity and price included in the contract, whenever the same is ordered in writing by the engineer, and such extra work shall be done in accordance with the specifications therefor, or as directed. Such work will be paid for at a unit price or lump sum to be agreed upon previously in writing by the contractor and the engineer; or where such a price or sum cannot be agreed upon by both parties, or where such method of payment is impracticable, the engineer shall authorize the contractor in writing to do such work under a supplemental agreement on a force account basis. (See Provision 09.04). The State shall not pay for, nor shall it be liable for, any extra work performed in the absence of or prior to a written authorization or order by the engineer to the contractor covering such work. All extra work done on a force account basis shall be adjusted daily upon report sheets furnished to the engineer by the contractor and signed by both parties. These daily reports shall be considered the true record of extra work done.

**04.05 CONSTRUCTION AND MAINTENANCE OF DETOURS.** Any existing road, while undergoing improvement, shall be kept continuously open to public traffic by the contractor; provided, however, that, except where otherwise indicated on the plans, the contractor may bypass traffic over a detour approved by the engineer. The contractor shall keep the road undergoing improvement, or the detour, as the case may be, continuously in a condition satisfactory to the engineer, that traffic will be accommodated during the entire contract period; he shall provide and maintain in safe condition temporary approaches and crossings; he shall keep open and safely passable, intersections with trails, roads and highways; provided, however, that snow removal will not be required of the contractor for the accommodation of traffic. The contractor shall bear all expense of constructing and maintaining such road, detours, approaches, intersections, and any accessory features without direct compensation, save as provided in (a) or (b) below.

**(a) Special Detours.** When the proposal form contains an item for "Maintenance of Detours," or "Removing Existing Structures and Maintaining Traffic," then the lump sum bid for such item shall cover all cost of constructing and maintaining such detour or detours, including the construction of any and all temporary bridges and accessory features and the removal of the same, and obliteration of the detour road, provided, however, that the contractor will not be required to provide right-of-way for temporary highways or bridges called for under this paragraph.

All or any portion of an existing structure that is suitable for use may be utilized in the detour; however, any modification of an existing structure or construction of a temporary structure shall be approved by the engineer prior to executing the work.



**(b) Suspension of Work.** Should the engineer, on account of unfavorable weather or other conditions not the fault of the contractor, authorize a suspension of construction operations the contractor shall make passable and shall open to traffic such portion of the highway under improvement and such temporary roadways or portions thereof as may be agreed upon between the contractor and the engineer for the temporary accommodation of necessary traffic during the anticipated period of suspension, unless otherwise provided in these specifications. Thereafter and until the issuance of an order for the resumption of construction operations, the maintenance of the temporary route or line of travel agreed upon shall be by and at the expense of the State. When work is resumed the contractor shall, at his own cost and expense, replace or renew any work or materials lost or damaged because of such temporary use of the highway under improvement; shall remove any work or materials used in the temporary maintenance thereof by the State; and shall complete the improvement in every respect as though its prosecution had been continuous and without interference. Provided, however, that this paragraph shall not apply where the contract contains an item for "Maintenance of Detours" or "Removing Existing Structures and Maintaining Traffic" in which case the contractor shall be responsible for the maintenance of traffic during the entire term of his contract.

If the contractor fails to comply with the provisions of this section, the engineer will immediately notify him that he must comply with the required maintenance provisions. Should the contractor fail to remedy unsatisfactory maintenance within twenty-four (24) hours after issuance of such notice, the engineer will immediately proceed with adequate forces and equipment to maintain the roadway or structure in a satisfactory and acceptable manner and the entire cost of this maintenance will be deducted from any moneys due the contractor.

**04.06 REMOVAL AND DISPOSAL OF STRUCTURES AND OBSTRUCTIONS.** All obstructions, structures not designated for use, obstructing fences, etc., shall be removed and disposed of by the contractor, or otherwise as may be directed by the engineer.

Payment for removal and disposal of structures and obstructions, unless otherwise designated in the contract, shall not be paid for as a separate item but shall be considered as covered by other bid items.

It is intended that all buildings within the right-of-way shall be moved by the owner prior to the beginning of grading operations by the contractor. If the buildings are not removed by the owner in time to prevent interference with grading operations they shall be removed by the contractor and payment therefor shall be made on a basis as provided for in Article 09.04.

**04.07 RIGHTS IN AND USE OF MATERIALS FOUND ON THE WORK.** The contractor may use, in the construction of the surface or structures any suitable stone, gravel, sand, timber or other materials found on the work that meet all the requirements of the specifications relating to character and quality for the particular use intended. Materials so used and paid for under some other item, will not be paid for as "Excavation," "Clearing," "Rip rap," etc., except that when materials contemplated for use in embankments are otherwise used by the contractor with the result that borrow, not originally contemplated, is necessitated the contractor will be paid on a basis that is most economical for the State. The contractor shall not excavate or remove any material from within the highway which is not within the excavation as indicated by the slope and grade lines, without written authorization by the engineer. In no instance will an item be paid for under dual identity.

**04.08 FINAL CLEANING UP.** Upon completion of the work and before acceptance and final payment shall be made, the contractor shall clean and remove from the highway, and adjacent property, all surplus and discarded materials, rubbish, and temporary structures, restore in an acceptable manner all property, both public and private, which has been damaged during the prosecution of the work and shall leave the highway in a neat and presentable condition throughout the entire length of the project.

If any gravel pit is so located as to be visible from the highway special care shall be taken by the contractor in making the final cleanup. The gravel shall be taken out so as to leave the side banks with as uniform lines as possible, and, if required by the engineer in order to produce a neat appearance, the side banks shall be neatly trimmed. The floor of the pit shall be left smooth and all piles of rock, wasted because they were too large to be handled by the crusher, shall be spread neatly over the floor of the pit or otherwise disposed of so as not to present an unsightly appearance. The strippings from all pits visible from the highway shall be neatly spread over the adjacent territory or shall be dragged into the pit and there spread as directed by the engineer unless the engineer orders that the strippings be left in ridges in order to act as wind breaks and snow barriers. No extra compensation shall be allowed for the final cleaning up of the gravel pits, but the cost thereof shall be included in the unit price bid for the materials in the finished course or courses. No contractor shall make any agreement with any landowners unless the prescribed cleanup shall be agreed upon and done.





**SECTION 5**

**CONTROL OF THE WORK**



**05.01 AUTHORITY OF ENGINEER.** All work shall be done under the direct supervision of the engineer and his authorized assistants. To prevent misunderstanding and litigation, the engineer shall decide any and all questions which may arise as to the quality and acceptability of materials furnished and work performed and as to the manner of performance and rate of progress of said work. He shall decide all questions which may arise as to the interpretation of any or all provisions contained in the contract as they pertain to the work, and all questions as to the acceptable fulfillment of the contract on the part of the contractor. The engineer's decision shall be final and conclusive, except that the contractor shall not be stopped from resorting to legal process in the event that the decision of the engineer with respect to the matters above enumerated is not acceptable.

**05.02 PLANS AND WORKING DRAWINGS.** Plans and working drawings will be furnished by the department and in all cases they will form a part of the contract. The plans will show, in detail, minor structures, alignments, grades, cross sections and typical cross section of the improvement. Bridge plans will be furnished and will show the general layout and features and all necessary details pertaining to structures. Such supplementary bridge and falsework plans, shop details, etc., as may be necessary shall be furnished by the contractor, but shall not be used until after approval of the engineer. No extra compensation will be allowed for such drawings. Alterations authorized by the engineer will be endorsed on approved plans or shown on supplementary sheets. Additional details relative to working drawings will be furnished as required. It shall be expressly understood that the approval by the engineer of the contractor's working drawings relates to the requirements for strength and detail and such approval will not relieve the contractor from the responsibility for errors in dimensions.

**05.03 CONFORMITY WITH PLANS AND ALLOWABLE DEVIATIONS.** The approved plans, profiles and cross sections will show the location, details and dimensions of the work contemplated. The designated work shall be performed in strict accordance therewith and in accordance with the specifications. Any deviation from the plans that may be required by the exigencies of construction will, in all cases, be determined by the engineer and authorized in writing.

**05.04 COORDINATION OF SPECIFICATIONS, PLANS AND SPECIAL PROVISIONS.** All requirements of the plans, specifications and special provisions shall be binding upon the contractor. On all plans and drawings the figured dimensions shall govern in case of discrepancy between figured dimensions and scaled dimensions. Modifications of these standard specifications may be indicated in the plans, supplemental specifications or the special provisions for a particular contract. (See Articles 01.52 and 01.64). In every case of such modification, or of discrepancies between the standard specifications and the plans and special provisions, the plans shall



govern over the standard specifications, the supplemental specifications over the standard specifications, and the special provisions shall prevail over all. The contractor shall not take advantage of any error or omission in the plans or of any discrepancy between the specifications and plans, and the engineer shall make such corrections and interpretations, in full accordance with the principles described above in this article, as may be deemed necessary for the fulfillment of the contract as a whole, as construed by him and his decision shall be final.

**05.05 COOPERATION BY CONTRACTOR.** The contractor will be supplied, by the engineer, with two sets of approved plans and special provisions, including authorized alterations thereof—one set of which the contractor shall keep available on the work at all times during its prosecution. He shall give the work his constant attention and shall cooperate with the engineer in every way possible.

The contractor shall have on the job site, at all times during his absence from the work during its prosecution, a superintendent, in active charge, who is capable of reading and thoroughly understanding the plans and specifications. The contractor shall notify the engineer, in writing, in advance of the start of work or, in advance of his absence, the name of his superintendent who shall be on the job site at all times while the work is in progress. The superintendent shall have full authority to execute orders or directions of the engineer without delay and to promptly supply such materials, tools, plant equipment and labor as may be required to satisfactorily perform the work.

When the contractor is comprised of two or more persons, co-partnerships or corporations, functioning on a joint venture basis, the contractor shall designate, in writing to the engineer, the name of the superintendent who shall have authority to direct the work and receive orders from the engineer to be received and obeyed by the contractor.

Where two or more contractors are engaged upon work on the same project, or section of project, or upon work in the same vicinity, each shall be responsible to the other for any damage, injury, loss or expense which may be suffered on account of interference of operations, neglect or failure to finish work at the proper time, or for any other reason. Each contractor shall confine storing of materials, tools, machinery or other equipment to his own respective right-of-way or other area outside of the highway so as not to interfere with or impede the work of the other.

**05.06 CONSTRUCTION STAKES.** The engineer will furnish and set all survey and grade stakes necessary for the guidance of the contractor in the prosecution of the work. The contractor shall furnish, free of charge, all templates and materials other than stakes necessary for making and maintaining points and lines given; and, without expense to the Commission, shall furnish the inspector such assistance or assistants as may be

required in giving points and lines necessary to the prosecution of the work. The contractor shall be held responsible for the preservation of all stakes and marks and if, in the opinion of the engineer, any of the survey stakes or marks have been carelessly or wilfully destroyed or disturbed by the contractor the cost to the Commission of replacing them will be charged against him and deducted from the payment for the work. Finished surfaces, in all cases, shall conform to the lines and grades given and as shown on the approved plans.

The crown rise of the finished surface of the roadways, from the curb or side-line to the center, shall be as shown on the typical cross section of the plans, except at intersecting highways, or wherever, to insure correct drainage or for other reasons, changes may be directed. On curves or at other places where deemed necessary, the contractor may be required to super-elevate one side of the roadway so that the finished surface shall slope in one direction.

**05.07 AUTHORITY AND DUTIES OF INSPECTORS.** Inspectors, employed by the Commission, will be authorized to inspect all work done and all materials furnished. Such inspection may extend to all or any part of the work and to the preparation or manufacture of the materials to be used; but such inspection shall not relieve the contractor from any obligation to perform all of the work strictly in accordance with the requirements of the contract. In case of any dispute arising between the contractor and the inspector as to materials furnished, or the manner of performing the work, the inspector shall have the authority to reject materials or suspend prosecution of the particular work affected until the questions at issue can be referred to and decided by the engineer. The inspector shall not be authorized to revoke, alter, enlarge, or relax any requirements of the contract, nor to finally approve or accept any portion of work, nor to issue instructions contrary to the provisions of the plans and specifications. Any advice inconsistent with the requirements of the contract, which the inspector may give the contractor, shall in no wise be construed as binding the engineer or the Commission in any way, nor releasing the contractor from the fulfillment of the terms of the contract. The inspector shall not be authorized to act as foreman for the contractor, nor to interfere with the management of the work.

**05.08 INSPECTION.** The contractor shall furnish the engineer with every reasonable facility for ascertaining whether the work as performed is in accordance with the requirements and intent of the contract. Any work done or materials used without suitable supervision or inspection by a Commission representative may be ordered removed and replaced at the contractor's expense.

**05.09 REMOVAL OF DEFECTIVE AND UNAUTHORIZED WORK.** Work done without lines and grades being given, or beyond the lines shown on the plans or as given, except as herein provided, or any extra work done without authority, will be considered as unauthorized and will not be paid for

under the provisions of the contract. All materials not conforming to the requirements of the specifications shall be considered as defective and all such materials, whether in place or not, will be rejected and shall be removed immediately from the highway unless otherwise permitted. All work which has been rejected or condemned shall be remedied or, if necessary, removed and replaced in an acceptable manner by the contractor at his own expense. Upon failure on the part of the contractor to comply promptly with any order of the engineer made under the provisions of this section, the engineer shall, after giving written notice to the contractor, cause defective work to be remedied, or removed or replaced, or cause unauthorized work to be removed and shall deduct the cost thereof from any compensation due or to become due the contractor.

**05.10 PLANT AND EQUIPMENT.** The contractor shall provide suitable equipment and plants adequate to produce acceptable work and/or materials in the required quality and quantity, when ordered by the engineer, and shall remove unsuitable equipment from the work and discontinue the operation of unsatisfactory plants.

**05.11 FINAL INSPECTION.** Final inspection of the work will be made by the engineer or his authorized assistant within fifteen (15) days after the final cleanup following completion of the project.





**SECTION 6**

**CONTROL OF MATERIAL**





**06.01 SOURCE OF SUPPLY AND QUALITY.** Only materials conforming to the requirements of the specifications, and approved by the engineer prior to use, shall be used in the work. The source of supply of each of the materials or finished products shall be subject to approval by the engineer before delivery is started. All materials proposed to be used may be inspected at any time during their preparation and use. The approved source of supply shall stand approved only so long as the materials conform to requirements. Any material which, after approval, has become mixed with or coated by any foreign substance during its delivery and handling shall not be used in the work.

Except as specifically stipulated in the proposal, the Commission will make no attempt to designate acceptable sources of supply for materials, and the unit bid prices in the proposal shall be understood to be based upon the use of satisfactory materials.

The State may acquire, and make available to the contractor, the right to take materials from those sources indicated on the plans and/or described in the proposal, together with the right to use such property as may be specified, adjacent thereto, as may be required for stockpiles and hauling roads. Materials taken from sources indicated on the plans and/or described in the proposal shall be paid for by the contractor at the rate specified therein. However, if the contractor fails to make the required payments, deductions sufficient to cover the cost of the materials will be made from estimates due him.

If the contractor desires to use materials from sources other than those indicated on the plans or described in the proposal, he shall, at his own expense, acquire the necessary rights to take materials and to use the property for plant sites, hauling roads, and other purposes, and pay all costs involved, including any which may result from an increase in length of haul. All costs of exploring and developing such other sources shall be borne by the contractor. The use of materials from other than those sources will not be permitted until representative samples, taken by the engineer have been approved by the laboratory and written authority issued for the use thereof. Approval for the use of material from such alternate sources will not be given unless the quality of the material therefrom is at least equal to the quality of material from the designated source or sources.

When sources of local materials are indicated on the plans or described in the proposal, the contractor shall satisfy himself as to the quantity of acceptable material available in such locations, and the State will not assume any responsibility (other than that provided in the following paragraphs) as to the quantity of acceptable material at those locations.

Designation of the source of supply, and of the acceptability of the material therefrom, does not extend to the grading of the material as it may naturally come from the crusher, unless otherwise specified; and it shall be the responsibility of

the contractor to adjust his crusher and screens, or to remove certain portions of the material, as may be necessary to furnish aggregate surfacing or other products that comply with the specifications including the grading of the material. No additional compensation will be allowed for such adjustment of equipment or for the rejection of excess and/or undesirable material. It is understood that the engineer may order procurement of material from any portion of any area designated as a pit or quarry site and may reject portions of the deposit as unacceptable. Where the source of material is furnished by the State, all strippings, excess, rejects or other by-products of any nature shall remain the property of the State and shall be stored adjacent to the plant site as directed by the engineer.

If, due to variations in quality, or for other reasons, it should be desirable to exhaust certain of the specified sources of materials prior to the exploitation of less desirable specified sources, the same will be noted in the proposal and plant set-ups by the contractor shall be made in the order noted.

When, in the opinion of the engineer, all of the acceptable material obtainable at any designated source has been exhausted, and it becomes necessary to move the entire plant to a previously undesignated location, the commission will reimburse the contractor for the actual cost of moving and erecting his plant at the new source of supply designated by the engineer. The Commission will reimburse the contractor, at actual cost, for any additional expense in connection with developing the new source of designated material.

No allowance will be made for moving the contractor's plant from one to another of the designated sources or from one location to another at any of the individual sources named, nor for the development of the same.

No extension of time will be allowed for loss of time due to moving the plant from one source of supply to another, except when all designated sources have been depleted or found otherwise unsatisfactory.

If the average haul on surfacing or other aggregate or borrow material is increased or decreased by a variation in the quantity available from each of the designated sources or by a change in the designated sources by order of the engineer, an adjustment will be made, either for or against the contractor, as the case may be, at the rate of ten (10) cents per ton-mile, or at the rate of fifteen (15) cents per yard-mile. Provided, however, that where there is an item for haul on any class of material, that price will govern with respect to the price to be paid for any additional haul on that particular material. Such adjustment, based on the determinations of the engineer, shall be full compensation for all expense the contractor may incur due to change in haul from that shown on the plans or noted in the proposal.

Sites from which material has been removed shall be left in a neat and presentable condition upon completion of the work, and all fences removed for purposes of entry shall be replaced in as good condition as they were before being removed. Development of deposits shall be as designated by the engineer and operations shall be so carried on as not to interfere with, or increase the cost of, future operations of the pit. The contractor shall take any necessary measures to prevent the entrance or egress of livestock from fields across which the haul road may be located.

The engineer reserves the right to change or substitute the type and/or grade of bituminous material to be used, depending on seasonal or other conditions; and in case of such change or substitution a supplemental agreement, in the form of a work order, shall be executed prior to the use of the materials.

The basis of payment for the changed or substituted bituminous material shall be the unit bid price for the respective type and grade of bituminous material called for in the contract, plus or minus the difference in cost to the contractor at the refinery between the type and/or grade called for in the contract and the changed or substituted type and/or grade.

**06.02 PLANT INSPECTION.** If the volume, progress of the work and other considerations warrant, the engineer may undertake the inspection of materials at the sources of supply. Plant inspection, however, will not be undertaken until the engineer is assured of the cooperation and assistance of both the contractor and the material producer. The engineer shall have free entry at all times to such parts of the plant as concern the manufacture or production of the materials ordered and the material producer shall furnish, free of charge, all reasonable facilities to assist in determining whether the material furnished meets with the requirements of the specifications. The engineer assumes no obligation to meet the inspection of materials at the source of supply and the responsibility of securing satisfactory materials rests entirely with the contractor.

The engineer reserves the right to retest all materials which have been tested and accepted at the source of supply after the same have been delivered and to reject all materials which, when retested, do not meet the requirements of the specifications.

The contractor shall give sufficient notification of the placing of orders for materials to permit testing.

**06.03 SAMPLES AND TESTS.** Samples, as prescribed or required, shall be submitted by the inspector, contractor or producer for testing. Tests shall be made in accordance with the standard specifications for methods of sampling and testing as adopted by the American Association of State Highway Officials insofar as covered therein. Test methods which are not covered in this publication shall conform to the standard specifications of the American Society for Testing Materials,

or by such other recognized standard methods as may be specified or described in the specifications or designated by the engineer. Where reference is made by serial designation to test methods or specifications of either the American Association of State Highway Officials' Standards or those of the American Society for Testing Materials, it is understood that the latest approved method or specification shall apply.

The contractor shall afford such facilities as the engineer may require for collecting and forwarding samples, and shall not make use of, or incorporate in the work, any material represented by the samples until the tests have been made and the materials found to be acceptable in accordance with the requirements of the specifications. The contractor shall furnish, without charge, all samples required.

When required by the engineer or requested by the contractor, representative preliminary samples of the character and quantity prescribed shall be submitted for examination and shall be tested in accordance with the methods referred to herein. The acceptance of a preliminary sample shall not be construed as acceptance of materials from the same source delivered later, unless such materials are found to be of equal or of better quality than the preliminary sample. Only the materials actually delivered for the work will be considered and their acceptance or rejection will be based solely on the results of the tests prescribed in the specifications.

**06.04 STORAGE.** Materials shall be stored so as to insure the preservation of their quality and fitness for the work. Stored materials shall be located so as to facilitate prompt inspection.

That portion of the highway not required for public travel, may be used for storage purposes and for the placing of the contractor's plant and equipment, but any additional space required shall be provided by the contractor at his expense. Where more than one contractor is engaged upon work on the same project or section of the project, or upon work in the same vicinity, the use of the highway for storage purposes, for placing the contractor's plants and equipment, or for camp purposes, shall be contingent upon such use not interfering with the construction operations of other contractors, and if ordered by the engineer, the contractor shall promptly move his stored materials, plant, equipment and camp to a location where it will not interfere with any construction operation.

**06.05 DEFECTIVE MATERIALS.** Materials not conforming to requirements shall be rejected and removed from the work and shall be replaced by acceptable materials and in an acceptable manner by the contractor and at his expense. The engineer may remove defective materials and charge the expense thereof against the contractor.







## SECTION 7

# LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC



**07.01 LAWS TO BE OBSERVED.** The contractor shall, at all times, observe and comply with all Federal and State laws, and local by-laws, ordinances and regulations in any manner affecting the conduct of the work, and shall indemnify and save harmless the State and all of its officers, agents and servants against any claim or liability arising from or based on the violation of any such law, by-law, ordinance, regulations, order or decree, whether by himself or his employees.

In carrying out work within or adjacent to a National Forest, the contractor shall comply with all of the regulations of the Department of Agriculture governing the protection of forests and the carrying out of work within National Forests, and shall observe all Federal and State Sanitary Laws and regulations with respect to the performance of work in forest areas. He shall keep the areas in an orderly condition, dispose of all refuse, obtain permits for the construction and maintenance of all construction camps, stores, warehouses, residences, latrines, cesspools, septic tanks and other structures in accordance with the requirements of the forest supervisor.

The contractor shall take all reasonable precaution to prevent and suppress forest fires, and shall require his employees and subcontractors, both independently and at the request of forest officers, to do all reasonably within their power to prevent and suppress, and to assist in preventing and suppressing forest fires, and to make every possible effort to notify a forest officer at the earliest possible moment of the location and extent of any fire seen by them and to extinguish the same if nearby and practicable.

It shall be the responsibility of the contractor to prevent the escape of fires set in the course of construction of the project, and to extinguish such as may escape, without expense to the State of Montana and the United States. Strict compliance with the laws governing burning operations during the designated fire season will be required at all times.

When the area through which the highway is being constructed lies within the jurisdiction of the Forest Service, or of a duly authorized State or local Fire Protection Agency, for the purpose of fighting fires in the vicinity of this project which are not caused by the contractor, the contractor, when requested by the forest officer, shall place his employees temporarily at the disposal of the forest officer; with the understanding, however, that payment to such employees for such services will be made by the United States or other agency concerned at not less than the current rate for such services established by the Forest Service in the area concerned, and any employees furnished will be relieved from fire fighting as soon as the forest officer in charge finds that it is practicable to employ other help adequate for the protection of the area. If the forest officer is on the ground, the fighting of the fire will be under his direction.

During the period from April 1st to November 15th of each year, spark arresters satisfactory to the forest supervisor in charge of the area concerned shall be maintained on all steam and gas driven machinery used on the project and on all flues at construction camps.

The contractor shall fully repair all damage, caused by his equipment, other than ordinary wear and tear, to roads and trails and any other improvements of the United States in the National Forests.

**07.02 PERMITS AND LICENSES.** The contractor shall procure all permits and licenses, pay all charges and fees, and give all notices necessary and incidental to the due and lawful prosecution of the work, except that nothing herein contained shall be construed as requiring the contractor to secure right-of-way for the road proposed for improvement.

**07.03 PATENTED DEVICES, MATERIALS AND PROCESSES.** The Commission assumes the responsibility of defending any and all suits brought for the infringement of any patent claimed to be infringed by the design, or general type of structure provided for in plans furnished the contractor by the Commission, and to hold the contractor harmless on account of such suits or claims for royalty.

The contractor assumes the responsibility of defending any and all suits brought for the infringement of any patent claimed to be infringed in any method, process, material or machinery which he may use in the execution of the work.

The contractor must assume all responsibility for plans submitted by him for the use of the engineer and shall hold the Commission harmless from any suits, royalty or damages on account of the infringement of any patents by said plans.

**07.04 RESTORATION OF SURFACES OPENED BY PERMIT.** Any individual, firm or corporation wishing to make an opening in the highway must secure a permit from, and will be required to deposit security with, the Commission in a suitable amount to cover the cost of making necessary repairs and the contractor shall not allow any person or persons to make an opening unless duly authorized by the engineer. Until the work performed under the contract has been accepted by the engineer the contractor shall make all necessary repairs, within the time indicated in writing by the engineer and in an acceptable manner, at any point or points in the roadway where any opening has been made by authority of the engineer. Such repair work will be paid for as "Extra Work," as indicated in the specifications and said work shall be subject to the same conditions as the work regularly performed under this contract.

**07.05 FEDERAL PARTICIPATION.** The attention of the contractor is directed to the provisions of the Federal Highway Acts and amendments thereto. When the United States Government is to pay a portion of the cost of construction, the Acts of Congress mentioned above provide that the construction work in each State shall be done in accordance with

its laws and under the direct supervision of the engineer, subject to the inspection and approval of the proper Federal authority and in accordance with the rules and regulations made pursuant thereto. The construction work, therefore, will be subject to such inspection by the properly authorized officer of the United States, or his agents, as may be necessary to meet Federal requirements but such inspection will in no sense make the Federal Government a party to this contract and will in no way interfere with the rights of either party. If required by the special provisions, all Federal Labor Laws shall be complied with and the contractor shall make all payroll records available to Federal inspection upon request.

**07.06 SANITARY PROVISIONS.** The contractor shall provide and maintain, in a neat and sanitary condition, such accommodations for the use of his employees as may be necessary to comply with the requirements and regulations of the State Board of Health or of other bodies or tribunals having competent jurisdiction. He shall commit no public nuisance.

**07.07 PUBLIC CONVENIENCE AND SAFETY.** The contractor shall at all times so conduct his work as to insure, in the greatest possible degree, the uninterrupted convenience and safety of the traffic and the public in the vicinity of the work. No road shall be closed to the public except by the express permission of the engineer. For additional instructions refer to Article 24.05, "Construction and Maintenance of Detours."

**07.08 BARRICADES, DANGER, WARNING AND DETOUR SIGNS.** Unless otherwise specified, the contractor shall furnish, erect and maintain all necessary barricades, red lights, warning and danger signals and signs. He shall, if necessary, provide flagmen and take such other precautions as are required for the protection of the work and for the safety of the public. Where lanterns, flares or any other artificial lighting is required, the illumination must be from sunset to sunrise hours. Should the contractor elect to use the reflectorized type signs specified in the standard drawings, no separate illumination need be provided. All barricades and signs must conform to standard drawings or be approved by the engineer. The payment for all such service and materials shall be considered as included in the other pay items of the contract. Flashing signals of an approved type may be acceptable for use.

**07.09 USE OF EXPLOSIVES.** In the use and storage of explosives, the contractor shall use every precaution to prevent injury to persons and damage to property. Secure storage places shall be provided and all such places shall be clearly marked with warning signs. Only persons experienced in the handling of explosives shall be allowed to use them on the work, and no shot shall be fired until warning has been sounded and all persons removed from the radius of danger. The number or intensity of charges shall be reduced whenever directed by the engineer.



In the handling and storage of explosives, the contractor must comply with all Federal, State and local laws and the State will in no way be responsible for any non-compliance therewith or for damages to property or injury to persons resulting from accidental or premature explosions or from any damage attributable to the use of such explosives.

**07.10 PRESERVATION AND RESTORATION OF PROPERTY, TREES, MONUMENTS, ETC.** The contractor shall be responsible for the proper preservation of all public and private property, monuments, etc., along and adjacent to the roadway. He shall use suitable precautions to prevent damage to pipes, conduits and other underground structures, and shall protect from disturbance or damage all land monuments and property marks until an authorized agent has witnessed or otherwise referenced their location and he shall not remove them until directed. The contractor shall not wilfully or maliciously injure or destroy shade trees or shrubs and he shall not remove or cut them without proper authority. He also shall use particular caution to prevent damage to existing structures and adjacent roadway surfaces which are required to be used in the execution of the contract.

The contractor shall be solely responsible for any trespass upon adjacent property or injury thereto, resulting from or in connection with his operations. He shall be liable for any claims that may be made on account of the falling of trees or the deposit of debris of any kind upon private property.

The contractor shall restore, replace or otherwise make good the loss or damage to the above described property, or upon notice from the engineer, may cause such restoration, replacement or indemnification and charge same against moneys due or to become due the contractor. The criterion for the repair or replacement of damaged structures or road surfaces is the condition of the structures or road surfaces at the time of start of work by the contractor.

**07.11 RESPONSIBILITY FOR DAMAGE CLAIMS.** The contractor shall save and keep harmless the State of Montana and any county, city or town thereof against and from all losses to it from any causes whatever growing out of the prosecution of the work.

The contractor shall carry public liability and property damage insurance to indemnify the public for injuries or damages sustained by reason of the carrying on of the work. The public liability insurance shall be in the amount of at least fifty-thousand (\$50,000.00) dollars for one person and a total of one-hundred-thousand (\$100,000.00) dollars for one occurrence. The property damage shall be in the amount of at least twenty-five-thousand (\$25,000.00) dollars for one occurrence and fifty-thousand (\$50,000.00) dollars in the aggregate. Work shall not be started until the contractor has submitted evidence to the Commission that he has taken out adequate insurance. Provided, however, that on contracts for



railroad grade separation structures, the contractor shall furnish insurance in the amount and kind set forth in Article 07.16 or the special provisions. Provided, in addition, that on contracts where the highway encroaches upon railroad right-of-way the contractor shall furnish insurance in the amount and kind set forth by the special provisions.

#### **07.12 OPENING OF SECTION OF HIGHWAY TO TRAFFIC.**

Whenever, in the opinion of the engineer, any roadway, or portion thereof, is in acceptable condition for travel and is required for the convenience of the public, it may be opened to traffic as directed and such opening shall not be held to be in any way an acceptance of the roadway, or any part of it, or as a waiver of any of the provisions of the contract. Necessary repairs or renewals made on any such section of the roadway so opened, due to defective materials or work or to cause other than ordinary wear and tear, pending completion and acceptance of the roadway shall be covered by Article 07.13.

If such roadway or portion thereof shall have been finished previously, in a manner acceptable to the engineer, the contractor shall be relieved of the maintenance thereof; but if it has not been previously so finished, it shall be maintained in a serviceable condition by the contractor, at this own expense, until such time as it is finished in an acceptable manner.

The acceptance of any portion or portions of the roadway prior to the acceptance of the work as a whole shall be understood to be an acceptance only insofar as it relieves the contractor of the maintenance of such portion or portions. It will not entitle him to payment of any part of the retained percentage and it will not relieve him from responsibility for defective workmanship or materials.

In the case of a contract for the placing of a surface course or courses upon a grade previously constructed under a separate contract, the contractor shall be required to maintain the subgrade ahead of other operations covering the preparation of the subgrade.

#### **07.13 CONTRACTOR'S RESPONSIBILITY FOR WORK. (a)**

Until its acceptance by the engineer, the improvement shall be under the care and charge of the contractor, and he shall be responsible for and shall repair and make good any injury or damage to the improvement or to any part thereof from any cause whatsoever; except that the contractor will not be held responsible for injury or damage to the improvement or any part thereof when, in the opinion of the engineer, such damage is not the result of careless negligent or dilatory work on the part of the contractor, but is the result of unforeseen natural causes beyond the control of the contractor, such as violent storms, cloudbursts and floods. The judgment of the engineer in this matter shall be final and binding upon both parties to the contract. When a contractor has, through dilatory methods and other causes within his control, exceeded his contract time unjustifiably, and has, therefore,

been denied an extension of his contract time the saving clause in the next preceding sentence shall not apply, but he shall be responsible for all damage of every nature.

(b) The above saving clause shall not apply to bridge contracts. The contractor, in submitting proposals for such work, must be governed by his own judgment as to probable weather and stream conditions and the actual resulting conditions will never be considered as unforeseen, but any loss or damage of any nature prior to acceptance of the improvement by the engineer shall be the responsibility of the contractor.

**07.14 NO WAIVER OF LEGAL RIGHT.** The Commission or the engineer shall not be precluded or estopped by any measurements, estimate or certificate made or given by them, or by any agent or employee of the Commission, under any provision or provisions of the contract, at any time, either before or after the completion and acceptance of the work and payment therefor pursuant to any measurement, estimate or certificate, from showing the true and correct amount and character of the work performed and materials furnished by the contractor, or from showing, at any time, that any such measurement, estimate, or certificate is untrue or incorrectly made in any particular, or that the work or materials, or any part thereof do not conform in fact to the provisions of the contract. The engineer shall have the right to reject the whole or any part of the aforesaid work or materials, should the said measurement, estimates, certificate or payment be found, or be known to be, inconsistent with the terms of the contract or otherwise improperly given. The Commission shall not be precluded and estopped, notwithstanding any such measurement, estimate, certificate and payment in accordance therewith, from demanding and recovering from the contractor and his surety such damage as it may sustain by reason of his failure to comply with the terms and provisions of the contract. Neither acceptance by the Commission, the engineer or any agent or employee of the Commission, nor any certificate by the Commission for payment of money, nor any payment for, nor acceptance of the whole or any part of the work by the Commission or engineer, nor any extension of time nor any possession taken by the Commission or its employees, shall operate as a waiver of any portion of the contract or of any power herein reserved by the Commission, or any right to damages herein provided, nor shall any waiver of any breach of the contract be held to be a waiver of any other or subsequent breach.

**07.15 FAMILIARITY WITH LAWS, ETC.** The contractor is assumed to have made himself familiar with all Federal and State laws and local by-laws, ordinances and regulations which in any manner affect the work or those engaged or employed in the work and no plea of misunderstanding will be considered on account of his ignorance thereof. If the bidder or contractor shall discover any provision in the contract which is contrary to or inconsistent with any such law, by-law, ordinance or regulations he shall forthwith report it in writing to the Commission.

The contractor's attention is directed particularly to the provisions and requirements of the Workmen's Compensation Act, Revised Codes of Montana and amendments thereto; also to the statutes regulating the hours of employment on public work.

The contractor shall, in the performance of all work under the contract, give such preference to honorably discharged personnel of the Armed Forces of the United States and to disabled civilians as is provided for in the Revised Codes of Montana and amendments thereto.

**07.16 CONTRACTOR'S RESPONSIBILITY FOR UTILITY PROPERTY AND SERVICE.** When and where the contractor's operations are adjacent to or in the same area as the properties, underground service facilities and other service lines, and particularly gas lines and cables carrying high voltage electrical current, belonging to public utility companies or other persons, or are adjacent to other property which might be damaged resulting in considerable repair expense, work shall not be commenced until all arrangements necessary for the protection thereof have been made. It shall be the responsibility of the contractor to contact the owners of said service and other facilities, or adjacent property, to determine what measures, if any, should be adopted to assure adequate protection of said facilities and to protect persons and property from any damage that might result if any of the service or other facilities were damaged. The contractor shall, having learned the locations of all such facilities and properties, mark and distinguish them so that his workmen may be governed accordingly. Extreme care shall be taken by the contractor in excavating and backfilling adjacent to any underground service lines or other underground facilities. When the contractor undertakes a project involving such circumstances he shall procure and carry insurance of a comprehensive type, coverage against underground damage and occurrences resulting therefrom, in addition to the insurance coverage required by the provisions of Article 07.11, "Responsibility for Damage Claims."

If it is necessary in the prosecution of the work to interrupt existing surface drainage, sewers, or underdrainage, temporary drainage facilities shall be provided and maintained at the contractor's expense until permanent drainage facilities are completed. The contractor shall be responsible for, and shall take all necessary precautions to protect and preserve any and all existing tile drains, sewers, or other sub-surface drains, conduits and other underground structures or parts thereof, which may be affected by the operations in the contract, and which in the opinion of the engineer, may be properly continued in use without any change. The contractor shall, at his own expense, satisfactorily repair all damage to such facilities or structures which may result from any of his operations or from his negligence during the period the contract is in force.

In order to cause a minimum of danger to railway traffic and to comply with the railway company's requirements whenever, during the construction, operations must be conducted in proximity to the tracks of the railway company the said operations shall be performed in such a manner as will not cause injury to persons or damage to the property of the railway company. The contractor shall give the railway company sufficient advance notice before such operations are commenced so that the railway company may provide flagmen or other representatives to protect the railway company's properties. The railway company will furnish the flagging service for the safe operation of their trains with their own forces and under their own rules and labor regulations and the contractor shall reimburse the railway company direct for the cost of such service, if any. All costs to the contractor for this flagging or other service will not be paid for directly, but it will be considered as subsidiary work pertaining to and absorbed in the various items of the contract.

All expenses incurred by this temporary protection shall be repaid the owner of the utility by the contractor. No separate payment will be made for these items, as it will be considered subsidiary work pertaining to the various items of the contract.

The contractor and his surety shall be solely and directly responsible to the owners and operators of such properties for any damage, injury, expense, loss, inconvenience or delay, or for any suits, actions, or claims of any character brought on account of any injuries or damages which may result from the carrying out of the work to be done under any contract and, if required by the Commission, he and his subcontractors shall furnish protective public liability and property damage insurance, in an amount specified by the Commission, to each corporation, company, partnership or individual owning or operating any of the properties affected, in guarantee of this responsibility. (See Article 07.11.)

The contractor and any of his subcontractors shall, for contracts involving work at railroad crossings or work within railroad right-of-way, provide and carry additional insurance as required by the special provisions included in proposals and contracts for such work.

**07.17 RIGHT-OF-WAY.** All right-of-way for the roadway shall be provided by the Commission without cost to the contractor. All right-of-way may not have been obtained at the time when the bids are opened and the proposal considered, and in that case the award will not be made until the entire right-of-way has been obtained. The submission of a bid will be construed as an acceptance of this condition by the bidder, and no claim for damage or loss of anticipated profits on account of unavoidable delay in securing right-of-way will be considered by the Commission. If the contract is materially delayed because of right-of-way difficulties, due consideration will be given by the Commission in extending the contract time to make proper allowance therefor.



**07.18 FUEL TAX RETURNS.** It is understood and agreed that the unit prices bid by the contractor shall include the State tax or its equivalent on all gasoline, diesel fuel, use-fuel, etc., used in the internal combustion of any and all engines used in connection with any or all work performed under this contract, including that used in the operation of stationary gas engines, motorized equipment and motor vehicles; and it is further agreed that such tax shall be paid by the contractor or by his subcontractor or employees, either at the source of purchase or to the State Highway Commission to be forwarded to the State Treasurer, and that if any refund of said tax is received by the contractor or by his subcontractors or employees, the amount thereof shall be credited to the Commission on accounts due to the contractor under this contract or shall be paid to the Commission by the contractor in cash or by certified check.

**(a) Quarterly Or Project Completion Returns.** For the purpose of determining the amount of the contractor's liability for the tax herein imposed, each contractor shall file with the Commission, on forms prescribed by the Commission, a quarterly tax return; provided, however, that the contractor may file a project completion tax return in lieu of quarterly tax returns upon giving the Commission notice of his election to file a project completion tax return within thirty (30) days of the date of this agreement. Failure to make an election will be construed as an election to file quarterly tax returns. The contractor shall file the return on or before the 20th day of the next succeeding calendar month following the quarterly or project completion period to which it relates; provided, however, that for good cause the Commission may grant the contractor a reasonable extension of time for filing, but not to exceed thirty (30) days.

**(b) Liquidated Damages.** If any contractor fails, neglects or refuses to file a tax return when due, the Commission shall, on the basis of information available to it, determine the tax liability of the contractor for the period for which no return was filed, and to the tax as thus determined the Commission shall add as liquidated damages the sum of one-hundred (\$100.00) dollars, or a sum equal to twenty-five (25) percent of the tax due, whichever is greater, together with interest at the rate of one (1) percent on the tax due, for each calendar month or fraction thereof, during which such refusal or failure continues, and the Commission shall have the right to deduct the amount of the tax liability and the liquidated damages from any moneys due the contractor on this project or any other project that the contractor has with the Commission; provided, however, that if the contractor shall establish to the satisfaction of the Commission that his failure to file a return within the time prescribed was due to reasonable cause the Commission shall waive the damages provided by this section.

**(c) Records.** It is understood and agreed that the contractor or subcontractor shall keep a record of the total number of gallons of fuel used and such other information as may



be required; and it is further agreed that the Commission, or its authorized representative, shall have the right to examine any of said books or records pertaining to the use and purchase of gasoline, diesel fuel, use-fuel, etc., in order to ascertain and determine whether the taxes due herein are being properly reported and paid. If such books or records are not maintained in this State at the time of demand, they shall be furnished to the Commission for review or the contractor shall bear the reasonable cost of examination, by an agent authorized by and designated by the Commission, at the place where such books or records are kept, provided the contractor shall not be liable for costs for a period exceeding one (1) week or for such longer period as he may consent to in writing, unless the result of said examination is the payment of a tax delinquency.

**07.19 MAINTENANCE OF IRRIGATION WATER.** Whenever, during the course of construction, it becomes necessary that irrigation water be made available for crops, the various structures, boxes, channel changes and culverts which are affected, or are related to irrigation, shall be constructed or moved in such manner as to maintain sufficient flow of irrigation water.

The contractor will not be permitted to shut off irrigation water in any irrigation ditch without first consulting the water master or owner of the ditch and securing written approval for the period during which water may be shut off in each and every irrigation ditch.

**07.20 RESTRICTED LOAD LIMIT FOR CONSTRUCTION EQUIPMENT.** The contractor shall use due caution in connection with the bridge or bridges either adjacent to or on the project and roadways adjacent to the project so that all equipment and loads utilizing the same shall be strictly governed by the existing laws relating to size and weight of motor vehicles, Revised Codes of Montana, 1947, and amendments thereto.

**07.21 EXEMPTION FROM PAYMENT OF THE FEDERAL TAX ON THE TRANSPORTATION OF MATERIALS.** Under the federal act which imposes a tax of three (3) percent on amounts paid for transportation of property by motor vehicle, rail, water or air, exemption from payment of the tax is allowed where property is transported to or from the government of a State and the shipping papers show the consignor or consignee to be such an organization.

In view of this situation and in order that the State may benefit from the exemption thereby allowed, the State Highway Commission hereby authorizes the contractor to whom this contract is awarded to have all shipments of materials destined to enter into the work covered by the contract, and to become the property of the State, consigned to the State Highway Commission of Montana in care of the contractor and to claim exemption from the transportation tax that would otherwise be imposed on such shipments.

This authority is granted to the contractor by the Commission with the understanding that the saving to be made by the exercise of this exemption privilege will be reflected in the prices bid for the contract work and will in that manner accrue to the benefit of the State by which funds for the work are contributed.

Exemption from the transportation tax does not apply to shipments of fuel, lubricants, spare parts, equipment, plant, consumable supplies, construction forms, form lumber or other items which do not become a part of the completed work or which do not become the property of the State, and the contractor is not, by these provisions, authorized to use the name of the State Highway Commission of Montana or the State of Montana in the consignment of shipments of such items.

**07.22 STATE CONTROLLED SOURCES OF MATERIALS.** It is hereby agreed that the State, its contractors, agents and employees, together with their machinery and equipment shall take the necessary precautionary measures to preclude the straying of livestock into or out of any designated State controlled source of materials.

It is also agreed that it shall be the contractor's obligation to respect and protect all irrigation facilities and that any damage resulting from his operations shall be promptly repaired or replaced to the landowners' satisfaction.



**SECTION 8**

**PROSECUTION AND PROGRESS**



**08.01 ASSIGNING OR SUBLETTING OF CONTRACT.** (a) **Assignment of Contract.** The contractor shall not assign, transfer, convey or otherwise dispose of his right, title or interest therein to any other person, firm or corporation without the written consent of the Commission.

The Commission will not recognize nor accept an advance "blanket" assignment by the contractor to any bank or other third party under the provisions of which all payments due, or to become due, the contractor are proposed to be paid direct to such third party rather than to the contractor. The Commission will recognize a request by the contractor to deposit payments to his credit in any stipulated bank.

(b) **Subletting.** The contractor shall perform with his own organization, and with the assistance of workmen under his immediate superintendence, work of a value not less than fifty (50) percent of the combined value of all items of work covered by the contract for each project; provided, however, that any work under the contract which will require highly specialized knowledge, craftsmanship and/or equipment not ordinarily available in contracting organizations qualified to bid on the project may be designated and shown in the advertised specifications as "Specialty Items" and the items so designated may be performed by subcontract without regard to the above limitation.

No portion of the contract shall be sublet, assigned or otherwise disposed of except with the written consent of the Commission. Requests for permission to sublet, assign or otherwise dispose of any portion of the contract shall be in writing and accompanied by the consent of surety and by a showing that the organization which will perform the work is particularly experienced and equipped for such work.

Each and every subcontract shall be in writing and shall provide that the work be performed in accordance with all the provisions of the agreement or contract obligating the general contractor. Certified copies of all subcontracts shall be furnished to the Commission for approval before execution by the parties to such subcontract and a copy of such approved subcontract shall be filed with the Commission after execution by the parties concerned.

Written consent to sublet, assign or otherwise dispose of any portion of the contract shall not be construed to relieve the contractor of any responsibility for the fulfillment of the contract. All subcontractors shall be considered the agents of the contractor and the latter shall be responsible for all work and material furnished and any indebtedness incurred by such agent. If any subcontractor fails to perform his work in a satisfactory manner his subcontract may be terminated by the engineer.

**08.02 CHARACTER OF WORKMEN AND EQUIPMENT.** The contractor shall, at all times, employ sufficient labor and equipment for prosecuting the several classes of work to full completion in the manner and time required by the contract.

All workmen must have sufficient skill and experience to perform properly the work assigned to them. All workmen engaged in special work or skilled work shall have sufficient experience in such work and in the operation of the equipment required to perform all work properly and satisfactorily.

All equipment which is proposed to be used on the work shall be of sufficient size and in such mechanical condition as to meet the requirements of the work and to produce a satisfactory quality of work. Equipment used on any portion of the project shall be such that no injury to the roadway, adjacent property or other highways will result from its use. The engineer may order the removal and require replacement of any unsatisfactory equipment.

Any foreman or workman employed by the contractor or by any subcontractor who, in the opinion of the engineer, does not perform his work in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the engineer, be removed forthwith by the contractor or subcontractor employing such foreman or workman, and shall not be employed again in any portion of the work without the approval of the engineer. If the contractor fails to remove such person or persons as required, or fails to furnish suitable and sufficient personnel for the proper prosecution of the work, the engineer may withhold all estimates which are or may become due, or may suspend the work until the contractor has complied with such orders.

No rental, including depreciation, will be allowed for any publicly owned equipment used by the contractor in the performance of the contract or on a force account basis unless authorized in writing by the engineer.

**08.03 LIMITATIONS OF OPERATIONS.** The contractor shall not open up additional work to the prejudice or delay of work already started, nor shall he inconvenience traffic more than is necessary as determined by the engineer. At no time during the prosecution of the work shall more than two (2) miles of roadway be under construction or obstructed to traffic without permission of the engineer. The final shaping of roadway ditches and borrow pits, the final finishing of earth graded roads and the fine grading of subgrade and shoulders shall follow the rough grading as closely as possible. If forward grading operations are unduly extended beyond finishing operations, they shall be suspended until all feasible finishing operations have been completed. Unless written permission is obtained from the engineer, placing of any surface course will not be permitted unless the contractor shall have at least one (1) mile of completely finished grade in advance of the placing of such surface course.

The contractor shall begin work at such points as the engineer may direct and shall thereafter prosecute the work at such points and in such order as may be prescribed from time to time by the engineer.



**08.04 CONTRACT TIME DETERMINATION.** (a) **Contract Time.** Time allowed for performance of the work, furnishing materials and completion of the contract will be determined by either the "Calendar Date" or the "Calendar Day" provision. The specific method for determining contract time will be stipulated in the proposal form and in the contract.

The calendar date method will determine the allowable time for performance of the contract by requiring that its completion be not later than a specified calendar date. Supplemental requirements of the method are described under Article 08.05—Calendar Date.

The calendar day method will specify the number of calendar days within which contract performance shall be completed. Supplemental requirements of the method are described under Article 08.06—Calendar Day.

(b) **Filing Insurance.** Within ten (10) days following the date of the proposal acceptance, the contractor shall file with the Commission the name of the liability insurance underwriter together with the amount of insurance coverage posted for the contract. The contractor will not be permitted, under any circumstances, to begin work without first having filed this information.

(c) **Contract Execution.** Payment will not be made for any work performed or for any materials delivered prior to execution of the contract by the contractor.

**08.05 CONTRACT TIME—CALENDAR DATE METHOD.** When the proposal form and contract provide that completion of work be accomplished by a designated calendar date—e.g. September 15—then this article shall apply as pertains to contract time and Article 08.06 shall not apply.

The contractor shall complete the work within the time limit specified, and elapsed time will be computed in calendar days. Requests for extension of contract time will be considered by the Commission only when it is clearly shown that, by a reasonable and possible increase in force and equipment, the contractor cannot complete the work within the time agreed upon. In planning his organization, the contractor must make allowance for lost time due to unfavorable weather and other conditions and must provide such force of men and equipment as may reasonably be expected to complete the work within the time specified.

If satisfactory completion of the contract shall require extra or additional work the time allowed for performance shall be increased in the same ratio that the total cost of the extra or additional work shall bear to the total cost in the proposal form.

If the contractor finds it impossible to complete the work on or before the time for completion specified in the contract he may, not less than ten (10) days prior to said date, make written request to the Commission for an extension

of time for completion. He shall set forth fully therein the reasons which he believes justify the consideration of his request. If the Commission finds that the work was delayed because of conditions beyond the control of the contractor, it may grant such an extension of time for completion as appears reasonable and proper.

The contractor shall not be assessed with liquidated damages nor the cost of engineering and inspection during any delay beyond the contract completion date caused by delay in awarding the contract, by inability to secure sufficient labor, by failure of the State to obtain right-of-way, by acts of God or the public enemy, acts of the State, fire, floods, epidemics, quarantine restrictions, strikes, boycotts, freight embargoes, or delays of subcontractors due to such causes; provided, that the contractor shall notify the engineer in writing of the causes of delay within ten (10) days from the beginning of any such delay, and the engineer shall ascertain the facts and the extent of the delay, and his findings of the facts thereon shall be final and conclusive.

The Commission will consider a request by the contractor for extension of time of completion of the contract on account of strikes, inability to secure sufficient laborers, time lost through delay in awarding the contract, or because of other unfavorable conditions clearly beyond the control of the contractor.

**08.06 CONTRACT TIME—CALENDAR DAY METHOD.** When the proposal form and contract provide that completion of work be accomplished within a designated number of calendar days—e.g. 250 calendar days—then this article shall apply and Article 08.05 shall not apply.

The contract time for performance of the work, furnishing of materials and construction of the project in its entirety shall be the number of calendar days set forth on the proposal form and in the contract, subject to possible extensions as specified elsewhere in this provision. A calendar day will be considered as a twenty-four (24) hour calendar date.

Upon written notice to the contractor of contract proposal acceptance by the Commission, the contractor is authorized to order required materials and prepare to begin the work contemplated by this contract. Normally, the notice of proposal acceptance will be issued the day following submittal of the contract proposal to the Commission.

At the end of the ten (10) day period following the date of the notice of said proposal acceptance the contractor, normally, will be forwarded notice to proceed with work. Assessment against the time allotted for performance of this contract shall begin ten (10) days following the date of notice from the engineer to proceed with work. Should circumstances, such as delayed materials, delivery or seasonal weather limitations distinctly not within control of the contractor, exist which would prevent completion of the work

within the time allotted, issuance of the "Notice to Proceed" may be withheld until such time as the circumstances in question have become normal or practical to the start of work.

No payment shall be made for any work performed or for any materials delivered under this contract prior to the date of execution of the contract by the contractor.

The contractor shall begin the work contemplated by this contract on or before the date provided for and shall prosecute the work continuously and with diligence to completion except when it is impossible to do so for reasons distinctly beyond his control. If the contractor desires to begin work prior to the effective date of the "Notice to Proceed," he shall be permitted to do so, provided that he has complied with all insurance requirements and that the physical conditions of the project are satisfactory.

The number of calendar days allowed for performance of the work contemplated by this contract is based on the quantities in the proposal form. If satisfactory fulfillment of the contract shall require the performance of extra or additional work, the time allowed for performance shall be increased in the same ratio that the total cost of the extra or additional work actually bears to the total cost in the proposal form.

Should it develop either prior to the actual start of work or during active construction of the project that delivery of commercial materials ordered for incorporation into the project is delayed in such manner as to retard scheduled starting or progress, a time credit to act as an extension may be considered.

Time credit will be considered only upon written application of the contractor within ten (10) days following occurrence of the delay and shall be accompanied by detailed data from the materials suppliers and/or allied services. Applications for time extensions on this basis will not be considered when the materials and/or services can be obtained from other commercial sources of supply.

## **08.07 PROSECUTION, SUSPENSION AND RESUMPTION OF WORK.**

### **A. Either Method Of Time Determination.**

It is agreed and understood that the contractor will prosecute the work contemplated under the contract with adequate equipment, labor and material and will carry on the work a sufficient number of hours and shifts each day on a schedule which will insure completion of the contract within the time specified.

The contractor shall notify the engineer, in writing, five (5) days in advance of the date he expects to start work and when he expects to begin important features of construction.

Operations will not be permitted at any time, other than daylight, on any class of work without written consent of the engineer. Permission to perform night work may be rescinded by the engineer at any time when, in his opinion, satisfactory results are not being obtained. Work at night will not be permitted, under any circumstances, unless the contractor furnishes flood lighting on the operations of sufficient intensity to insure the same degree of accuracy and quality of workmanship as would be obtained by daylight. Lights on equipment employed in performance of the work will not be accepted as satisfactory lighting.

The necessity of suspending and resuming work on any portion of the contract will be determined by the engineer. He shall have authority to suspend the work, wholly or in part, for such period or periods as he may consider necessary. He will give consideration to unsuitable weather or to such other conditions as are considered unfavorable for the suitable prosecution or protection of the work, or for such time as is necessary through failure of the contractor to carry out orders given or to perform any or all provisions of the contract.

The contractor shall not suspend work under the contract without a written order by the engineer. Suspension of the work ordered by the engineer shall not furnish grounds for claims by the contractor for damages or extra compensation for a period of work suspension. The question as to the necessity of discontinuing any portion of the work for reason of unfavorable conditions shall be determined by and shall be at the authority of the engineer. Upon failure or negligence on the part of the contractor to carry out the order of the engineer to perform work under the contract in accordance with the provisions thereof, the engineer may suspend the work for such period as he considered necessary. Time lost by reason of such failure or negligence or in replacing improper work or materials shall not furnish grounds to the contractor for claiming an extension of time or extra compensation and shall not release the contractor from any damages or liability for failure to complete work within the allotted contract time. The contractor shall take every precaution to prevent any damage or unreasonable deterioration of the work during the time operations are closed down.

Should it become necessary to suspend work for an indefinite period, the contractor shall store all materials in such manner that they will not obstruct or impede the traveling public nor become damaged in any way. He shall take every precaution to prevent damage or deterioration of the work performed, provided suitable drainage of the roadway by opening ditches, shoulder drains, etc., and undertake any other precautions the engineer may direct. The contractor shall not suspend work under the contract without a written order from the engineer.

Suspensions involving cessation of work on all items, except minor construction not affected or connected with the cause of suspension, shall be considered as a total suspension.



Time spent on work of an emergency nature ordered by the engineer for the convenience of public traffic or time spent on the production of materials for storage if performed during a period of total suspension will not be charged against contract time. Where all work is completed but deferment of final inspection and acceptance is necessary due to causes not within control of the contractor, and due solely to that cause, no time charge shall accrue against the contractor for such elapsed period.

If, for any reason, the contractor shall suspend operations during the construction life of the contract, without a written order from the engineer, he shall be responsible for and shall at his own expense furnish all work and materials required for satisfactory maintenance of the project and/or its restoration accrued during the delayed period.

The contractor shall reimburse the State for all field project engineering charges accrued during the delaying period resulting from his actions in suspending operations. These charges shall be considered separate and apart from any liquidated damage assessment.

#### **B. Calendar Date Method.**

The contractor shall begin the work to be performed under this contract within ten (10) days after the execution of the contract therefor, except as herein provided. The work shall be conducted in such a manner and with sufficient materials, equipment and labor as will insure its completion within the time set forth in the contract. If the contract is awarded at such season of the year as to make starting of work impracticable or impossible, work shall be started within ten (10) days of receipt of written notice from the engineer stating that conditions are such as to permit starting of operations. Should the prosecution of work for any reason be discontinued by the contractor, with the consent of the engineer, he shall notify the engineer at least forty (40) hours before again resuming operation.

#### **C. Calendar Day Method.**

It is agreed and understood that the contractor will attend the work contemplated under this contract with adequate equipment and labor and will carry on the work a sufficient number of hours and shifts each day on a schedule which will insure completion of this contract within the number of calendar days allotted.

The necessity of suspending and resuming work on any portion of the contract shall be determined by the engineer. If the engineer believes that unfavorable working conditions or unavoidable delay conditions exist, due to no fault of the contractor, which would warrant suspension of the work he shall issue to the contractor a written order to suspend work. The order to suspend work shall show the detailed reason for suspension and also shall show the number of calendar days elapsed to date and the number of calendar days remaining in which to complete the contract. When conditions are again



favorable for prosecution of the work, the engineer shall issue to the contractor a written order to resume work which shall show the number of calendar days remaining in which to complete the contract. The calendar days of suspended or shutdown period, in cases of this nature, shall not be charged against the time allowed for performance of the contract work. No time allowance will be granted as the result of a partial suspension of work.

**08.08 UNAVOIDABLE DELAYS.** Assessment shall not be made against the time allowed for performance of the work contemplated by the contract for delays not due to any fault or negligence of the contractor or delays in awarding the contract, acts of the State, acts of the Federal Government, acts of God, acts of the public enemy, fire, flood, epidemics, quarantine restrictions, national or regional labor strikes, boycotts, freight embargoes or, when in the judgment of the engineer, unfavorable weather of prolonged duration renders it impossible for the contractor to secure specified contract results.

An act of God is construed to mean an earthquake, flood or other catastrophic phenomenon of nature beyond the power of the contractor to foresee or make preparation in defense of.

A rain, windstorm or other natural weather phenomena of normal intensity, based on past experience for the locality, shall not be construed as an act of God and no time credit will be granted for delays resulting therefrom except as covered by suspension and resumption orders as provided elsewhere in these provisions.

Time credit for delays resulting from these causes will be considered only upon written application of the contractor submitted within ten (10) days following their occurrence.

**08.09 FAILURE TO COMPLETE THE CONTRACT ON TIME.** It is understood and agreed that time is the essence of the contract and that the work must be completed within the time specified in the proposal and contract. If the contractor fails to complete the work within the time specified, or within any authorized extension thereof, and if the Commission does not terminate the right of the contractor to proceed, the contractor shall continue and complete the work. Under such circumstances the actual damages for the delay will be impossible to determine and in lieu thereof the contractor shall pay to the Commission, as fixed and agreed, liquidated damages for such calendar day that the work shall remain uncompleted beyond the specified completion date and/or exceed the specified number of calendar days, as the case may be, the sum set forth in the following schedule. The contractor shall be liable for the payment of the amount thereof, which amount shall be deducted from the final payment due the contractor under the contract.

**SCHEDULE OF LIQUIDATED DAMAGES**

<b>Proposal Total</b>	<b>Liquidated Damages</b>
Less than \$10,000.....	\$ 20.00 per day
\$10,000 and less than \$25,000.....	\$ 30.00 per day
\$25,000 and less than \$50,000.....	\$ 50.00 per day
\$50,000 and less than \$100,000.....	\$ 60.00 per day
\$100,000 and less than \$200,000.....	\$ 70.00 per day
\$200,000 and less than \$300,000.....	\$ 80.00 per day
\$300,000 and less than \$500,000.....	\$100.00 per day
\$500,000 and over.....	\$200.00 per day

**08.10 ANNULMENT OF CONTRACT.** If the contractor fails to comply with any of the requirements of the plans or specifications, or shall discontinue the prosecution of the work, or if the contractor shall become insolvent or bankrupt, or commit any act of bankruptcy or insolvency, or allow any final judgment to stand against him unsatisfied for a period of ten (10) days, or shall make an assignment for the benefit of creditors, or from any other cause whatsoever shall not carry on the work in an acceptable manner the engineer shall, upon receipt of such information, give notice in writing to the contractor and his surety of such delay, neglect or default, specifying the same and if the contractor within a period of ten (10) days after such notice shall not proceed in accordance therewith, then the Commission shall, upon written certificate from the engineer of the fact of such delay, neglect or default and the contractor's failure to comply with such notice, have full power and authority, without violating the contract, to take the prosecution of the work out of the hands of said contractor to appropriate or use any or all materials and equipment on the ground as may be suitable and acceptable and may enter into an agreement with any other person or persons for the completion of said contract according to the terms and provisions thereof, or use such other methods as it may deem expedient for the completion of said contract in the specified manner. All costs and charges incurred by the Commission, together with the costs of completing the work under contract, shall be deducted from any moneys due, or which may become due, said contractor. In case the expense so incurred by the Commission shall be less than the sum which would have been payable under the contract, if it had been completed by said contractor, then the said contractor shall be entitled to receive the difference; and in case such expense shall exceed the sum which would have been payable under the contract then the contractor and the surety shall be liable and shall pay to the State the amount of said excess.

**08.11 TERMINATION OF CONTRACT BEFORE COMPLETION WITHOUT FAULT OF THE CONTRACTOR.**

The Commission shall have the right to terminate any contract at any stage of completion without fault of the contractor, when in the event of a national emergency or for other reasons beyond the control of the Commission, such termination becomes necessary to the best interest of the State, and written notice of such termination is given the contractor. Upon such termination, the contractor shall be entitled to the full amount of the estimate, including any retained percentage, for the work actually done by him under the terms and conditions of the contract up to the date of service of the notice of termination. In addition, the contractor shall be reimbursed by the Commission for expenditures which, in the judgment of the engineer, are not otherwise compensated for and as are required in preparing for, moving to and from the job and for materials on hand. It is the general intent that an equitable settlement shall be made with the contractor.

Notice shall be considered to have been served upon the contractor when delivery to the person in charge of any office used by the contractor, the contractor's superintendent, or other authorized representative in charge of the job has been completed or such notice has been sent by registered mail to the contractor at his last known place of business.

**08.12 TERMINATION OF CONTRACTOR'S RESPONSIBILITY.** The contract shall be considered to have been completely fulfilled when all work has been completed and accepted by the Commission and the final estimate has been accepted by the contractor and paid. The contractor shall then be released from further obligation under the contract except as set forth in his contract bond.





SECTION 9

MEASUREMENT AND PAYMENT





**09.01 MEASUREMENT OF QUANTITIES.** The determination of quantities completed under the contract will be made by the engineer, based upon actual measurement of the work according to the United States standard measures. All lengths and distances shall be measured horizontally unless otherwise shown on the plans. In computing volumes, the method of average end areas will be used for excavation and embankment. The area of surfacing to be paid for will be only the actual area covered by the entire surfacing or paving material within the lines designated or given, except that no deduction will be made for fixtures in the roadway or street of four square feet or less. Concrete and other similar structures will be measured, and the volumes will be computed, according to the neat lines shown on the plans or ordered by the engineer. Other quantities will be computed in units indicated in the proposal form according to well established engineering principles and no local rules or customs at variance therewith will be considered. When the proposal calls for payment on a ton basis the unit shall be the ton of 2,000 pounds.

**09.02 SCOPE OF PAYMENTS.** The contractor shall receive and accept the compensation as herein provided in full payment for all work contemplated and embraced under the contract; also for all loss, damage or expense of whatever character arising out of the nature of the work or the prosecution thereof. The payment of any current or final estimate, or of any retained percentage, shall in no way or in no degree prejudice or affect the obligation of the contractor to submit for final acceptance a completed improvement in accordance with the requirements of the plans, specifications and supplemental agreements.

The contractor shall make payment promptly for labor and material, at such times as claims become due and payable, to all persons supplying said contractor therewith for the prosecution of the work contemplated herein, and he shall not permit any lien or claim to be filed or prosecuted against the State of Montana, or any officer, agent or employee thereof for or on account of any labor or material furnished.

**09.03 PAYMENT AND COMPENSATION FOR ALTERED QUANTITIES.** When alterations in plans or quantities of work not requiring supplemental agreements as hereinbefore provided, are ordered and performed, the contractor shall accept payment in full at the contract unit prices for the actual quantities of work done. In no case of altered quantities will any allowance be made for any increased expenses, loss of expected reimbursement, or loss of anticipated profits suffered or claimed by the contractor resulting either directly from such alterations, or indirectly from unbalanced allocation among the contract items of overhead expense on the part of the bidder and subsequent loss of expected reimbursement therefor, or from any other cause.

Concrete quantities shown in the bidding schedule may have been increased 10 per cent and roadway and structure excavation quantities 7 per cent in order to cover possible overruns but only accepted quantities actually entering into the final construction will be paid for.

**09.04 EXTRA AND FORCE ACCOUNT WORK.** Extra work as hereinbefore described under Section 4, "Scope of Work," shall be paid for either at agreed unit prices under the provisions of a "Supplemental Agreement," or on a "Force Account" basis, as shall have been agreed by the engineer and contractor before starting said work.

**A. Supplemental Agreement.** When it has been agreed to perform certain extra work not contemplated in the original proposal and contract on the basis of agreed prices, a "Supplemental Agreement" will be prepared. It shall describe, fully and completely, said extra work, including the approximate quantity as nearly as may be determined in advance of the performance of the work, and the agreed unit prices. This "Supplemental Agreement" shall be executed by both parties to the original contract, shall thereupon be considered a part of the contract and payment for the work included therein shall be for the actual quantity performed at the agreed unit prices set forth therein. Extra work provided for by a "Supplemental Agreement" shall not be started until after the execution of the said agreement.

**B. Force Account Work.** Where extra work on a "Force Account Basis" has been ordered by the engineer in writing as provided under Section 4, "Scope of Work," it shall be paid for in the following manner:

- (a) For all labor, teams and foremen in direct charge of the specific operation, the contractor shall receive actual direct payroll cost plus 15 per cent.
- (b) For all materials used, the contractor shall receive the actual delivered cost of such materials as shown by original receipted bills, plus 10 per cent.
- (c) For any machine-power tools or equipment, including fuel and lubricants, which it may be deemed necessary or desirable to use, the engineer shall allow the contractor a reasonable rental price, to be agreed upon in writing before such work is begun, for each and every hour or day that said tools or equipment are in use on such work and to which sum no percentage shall be added.
- (d) For Workmen's Compensation Insurance, Public Liability and Property Damage Insurance, and premium on the performance bond, and such other expense as might be imposed on the contractor by Federal and State laws, the contractor shall receive the actual cost thereof chargeable to the force account work, to which no percentage shall be added. The contractor shall furnish satisfactory evidence of the rate or rates paid for insurance and bond.

- (e) The compensation as herein provided shall be received by the contractor as payment in full for extra work done on a "force account" basis, and shall include superintendence, use of tools and equipment for which no rental is allowed, and profit. The contractor's record of extra work done on a "force account" basis shall be checked by the inspector at the end of each day and a copy of these records, signed by both the inspector and the contractor's representative, forwarded to the engineer. All claims for extra work done on a "force account" basis shall be submitted on estimate forms furnished by the Commission, accompanied by the original extra work order and receipted material and freight bills. Such claims shall be submitted to the engineer not later than the 10th day of the month following that in which the work was actually performed.

Payment for extra work will be made as provided for in these specifications.

**09.05 OMITTED ITEMS.** It is hereby provided that the engineer may order omitted from the contract items included in the original contract which may later be found unnecessary to the improvement, without thereby in any manner nullifying the contract or any of the other provisions thereof; provided however, that when the contractor has paid for material or incurred other expense in relation to any such item, before the elimination of same is ordered, he shall be reimbursed for his actual costs as evidenced by said invoices, paid time checks and other similar evidence which may be demanded by the engineer to fully support the cost statement of the contractor. In no case of this sort shall any allowance be made for anticipated profits.

**09.06 UNAUTHORIZED WORK.** Work done without lines or grades being given, work done beyond the lines or grades shown on the plans or as given, except as herein provided, or any extra work done without written authority, will be considered as unauthorized and at the expense of the contractor and will not be measured or paid for. Work so done may be ordered removed or replaced at the contractor's expense. In measuring quantities no allowance will be made for excavation or embankment in excess of that required by the sections shown on the plans unless such increase in quantity has been authorized in writing by the engineer.

**09.07 PARTIAL PAYMENTS.** The engineer shall make estimates, in writing, each working month of the materials in place complete and the amount of work performed, including "extra material and extra work" in accordance with the contract, during the preceding month and the value thereof at the unit prices contracted.

The Commission shall retain 10 per cent of each monthly estimate until after the completion of the work, subject to the provision that the amount retained shall be the nearest

\$100.00 above 5 per cent of the total amount of the contract. The total amount of the estimate, less the amount retained, will be certified by the Commission to the State Board of Examiners for payment except when such balance amounts to less than \$500.00. In case the amount earned during any one month, less the amount retained, shall be less than \$500.00, no payment will be made except on the final estimate.

If the total amount of the retained percentage is greatly in excess of the value of the uncompleted and unaccepted portion of the contract the Commission may, upon recommendation of the engineer and consent of the surety, allow the contractor a portion of this suspended payment, provided that the Commission shall at all times retain an amount sufficient to enable the State to complete the unaccepted or uncompleted work in the contract and liquidate unsatisfied claims. Partial payments shall not be evidence of acceptance of unsatisfactory work or material.

**69.08 ACCEPTANCE AND FINAL PAYMENT.** Whenever the contractor shall have completed the work in accordance with the terms of the contract, the engineer will make final inspection of the work and upon completion of repairs, renewals or other work found to be necessary, if any, he will certify to completion and recommend to the Commission that final acceptance of the project be made and such final acceptance will be made by the Commission at its next regular meeting after receipt of the certificate of completion and recommendation from the engineer. Upon acceptance of the completed contract by the Commission the engineer will notify the contractor and his surety of the acceptance.

The statutory time, ninety (90) days, for filing claims against the contract bond shall date from the day of final acceptance of the project by affirmative action of the Commission—see Sections 6-401 to 6-404, inclusive, Revised Codes of Montana, 1947, as amended.

The Commission reserves the right to withhold payment of the contractor's final estimate until any and all just claims filed with the Commission against the contract bond have been settled. If there are no claims filed within the thirty day period following the formal acceptance of the project by affirmative action of the Commission, payment of the final estimate will be made.

Also, should a claim or claims be filed with the Commission against the contract bond after the stipulated thirty day period has expired, the Commission reserves the right to withhold payment of the final estimate, at the discretion of the engineer, until notice of satisfaction of claim or claims has been received.

The engineer shall immediately notify the contractor and his surety of all claims filed against the contract bond.



If, at the end of the stipulated thirty day period, no claims have been filed with the Commission against the contract bond, the engineer will request formal permission from the contractor's surety to pay the final estimate.

The payment of the final estimate by the Commission at the expiration of the stipulated thirty day period does not in any way relieve the contract bond of its responsibility for any unsatisfied claim or claims filed with the Commission during the remaining portion of the statutory period.

After notifying the contractor and his surety of Commission acceptance, the engineer will prepare the final estimate, including therein the amount and value of each class of work performed, including any "extra work" and "extra materials." Upon settlement of any claim or claims filed and expiration of the thirty (30) days estimate retaining period, whichever arrives first, or in the case of no claims filed, the engineer will transmit to the contractor a claim embodying the final estimate. Accomplishment of the affidavit on the final estimate claim by the contractor shall constitute full acceptance by him of the total amount shown as the entire amount due him under the contract.

Upon return by the contractor of the accomplished final estimate claim, it shall be certified by the Commission to the State Board of Examiners for payment and payment thereof shall constitute, together with previous partial payments, full satisfaction for the total amount due under the contract. Erroneous or overpayments made by previous and partial payments shall be subject to correction in the final estimate.





## SECTION 10

# CLEARANCE OF RIGHT OF WAY



**SUBSECTION 10.00—CLEARING.**

**10.01 DESCRIPTION.** "Clearing" shall consist of the removal and disposal of trees, stumps, brush, windfalls, logs, vegetation and other objectionable matter occurring within the clearing limits, as hereinafter defined, or which interfere with excavation, embankment or the designated clear vision areas.

**10.02 CONSTRUCTION METHODS.** (1) All areas of the right of way so designated on the plans and/or shown in the proposal, and all areas between lines five (5) feet outside of the grading limits for cuts, channels, ditches, material sites and sources and within neat lines of fill areas, shall be cleared. If slopes are to be rounded, the clearing area shall extend to the outside limits of the slope rounding. Unless specifically designated to be saved, all trees, stumps, brush, windfalls, logs and other objectionable matter occurring within clearing limits shall be cut off and disposed of as hereinafter provided. All stumps within the right of way limits and all trees, the stumps of which are not to be grubbed, shall be cut not more than the diameter of the stump, and in any instance not more than twelve (12) inches, above the ground.

(2) Removal of live trees from within the area between the right of way lines and the clearing limits, as defined in the preceding paragraph, will not be required or permitted except as may be necessary to protect slopes or to add to the safety of the highway. However, all dead trees and windfalls shall be removed and underbrush and debris shall be cleaned from the entire width of the right of way. All stumps shall be cut as prescribed in the preceding paragraph. Cleaning up of windfalls shall include the disposal of any uprooted stumps.

(3) Timber having commercial value shall be cut into logs in accordance with established logging practice. Any loss from breakage, due to unskilled or careless felling or handling, may be charged back against the contractor. Logs shall be decked along the highway, free of cuts or fills, at points convenient for loading, and shall remain the property of the State. No National Forest timber may be cut or destroyed without first communicating with the National Forest Service Officer responsible for the area concerned. All timber cut from the National Forest land shall remain the property of the United States, to be disposed of as the Forest Service Officer may determine.

(4) All trees shall be felled within the area to be cleared, and all brush, stumps, waste logs, limbs, tops, roots, duff, and other debris resulting from clearing, which is not of commercial value, shall be placed in piles and burned in such a manner as to be completely consumed. If the burning is to precede the construction operations the piles may be placed in the center of the right of way; otherwise the piles should be placed in the most convenient place to the side of the right of way and beyond fill slopes, where they may be burned without damage to the surrounding forest cover. In no case will it be permissible merely to throw the refuse out-

side of the right of way or into streams or lakes. The material placed in piles shall be burned by the contractor, unless otherwise specified, at such time and in such manner as will prevent the fire from spreading to areas adjoining the right of way.

(5) The contractor shall avoid, as far as practicable, injury to shrubbery, vines, plants, grasses and other vegetation growing on areas outside of the slope limits of excavation and embankments. The dragging, piling and burning of clearing debris, and work which may be injurious to vegetation shall, insofar as is practicable, be confined to areas which carry no vegetation or which will necessarily be covered by embankments or disturbed by excavations. The provisions of this paragraph are not to be construed as relieving the contractor of the clearing of dead vegetation, logs, stumps, limbs, sticks and other undesirable matter occurring on areas where live shrubbery, brush, trees, and other desirable vegetation are to be left in place.

(6) All timber, except that designated as having commercial value, and all slash and debris resulting from clearing and construction operations shall be disposed of either by piling and burning or by any other method agreeable to the Forest Service Officer who shall see to its removal from the area. Piles made for burning at a later date shall be located in places where burning will not injure uncut green timber growth of any size, and provided further that any burning undertaken shall be done only at such times, in such manner, and under such conditions or arrangements as may be prescribed beforehand by the Forest Service Officer.

**10.03 METHOD OF MEASUREMENT.** (1) General. The boundaries of the area to be cleared will be established by the engineer by the use of stakes, lath, flags or other satisfactory means. Areas between the right of way lines and the clearing limits, which require cleaning up and the disposal of underbrush, dead timber, logs, stumps, windfalls and other debris, shall be cleared by the contractor as a part of his obligations under this bid item.

(2) Acre basis. When "Clearing" has been bid at a unit price per acre, the acreage to be measured and paid for will be the number of acres, computed to the nearest hundredth, actually cleared and accepted as complete. Appropriate deductions will be made for cleared acreage of existing rights of way coincident with the right of way of the project under construction. Acreage will be determined from horizontal measurements.

(3) Lump Sum Basis. When "Clearing" has been bid at a lump sum price the item shall include all necessary "clearing," as defined and described in this subsection, involved in the satisfactory completion of the project.

**10.04 BASIS OF PAYMENT.** (1) If there is some "Clearing" work that should be performed, on the project, and there is no "Clearing Item" in the proposal then it is understood and

agreed that the necessary clearing shall be done by the contractor, in accord with the provisions of this subsection, but that payment for the work shall be presumed to be included and absorbed by the prices bid for other items.

(2) This item, when included in the proposal, shall be paid for on the basis upon which it was bid, which price and payment will be full compensation for all labor, equipment, tools and incidentals necessary to complete the item.

Item Number	Item Description	Unit
1001	Clearing	Acre
1002	Clearing	Lump Sum

### SUBSECTION 10.10—GRUBBING

**10.11 DESCRIPTION.** Grubbing shall consist of the excavation, removal and disposal of roots, stumps, stubs, together with duff, matted roots, and buried debris from the grubbing limits, as hereinafter defined, unless otherwise specified on the plans or directed by the engineer.

**10.12 CONSTRUCTION METHODS.** (1) All areas of the right of way so designated on the plans or in the proposal, and all areas between lines five (5) feet outside of the grading limits for cuts, channels, ditches and pits, and all areas to be covered by embankments less than three (3) feet in height, shall constitute the grubbing limits. All stumps, roots, logs or other timber more than three (3) inches in diameter and all brush, matted roots and other debris within the grubbing limits, not suitable for road foundation, shall be pulled or otherwise removed to a depth of not less than twelve (12) inches below the original ground surface.

(2) All material resulting from grubbing operations shall be piled and burned as stipulated under Subsection 10.00 Clearing, provided, however, that any such material not disposed of by burning shall be disposed of out of sight from the highway or neatly piled not less than three hundred (300) feet outside of the right of way, and written permits for such disposal shall be obtained by the contractor from the owner of the property upon which the material is placed and such permits or copies thereof shall be filed with the engineer.

(3) Burning of grubbing debris shall normally be performed prior to grading operations; however, in the event burning permits cannot be secured from the proper authorities at the time contemplated for disposal of such debris, failure to secure such permits shall not be cause for delay in removal of grubbing debris from within areas affected by other operations. In such event the work under the item of "Grubbing" shall be construed to include placing of grubbing



debris beyond the limits affected by other work until such time as burning permits can be secured, and rehandling and disposal of such debris done without delay to other work. Grubbing shall be kept at least one thousand (1,000) feet ahead of grading operations. All depressions below the final surface of the ground, resulting from the grubbing operations, shall be backfilled with suitable material. Material secured from excavation operations for this backfilling will be paid for as provided under Subsection 11.00 "Roadway, Drainage and Borrow Excavation" and Section 12, "Overhaul."

**10.13 METHOD OF MEASUREMENT.** (1) **General.** The boundaries of the areas to be cleared will be established by the engineer by the use of stakes, lath, flags or other satisfactory means.

(2) **Acre Basis.** When "Grubbing" has been bid at a unit price per acre the acreage to be measured and paid for will be the number of acres, computed to the nearest hundredth, actually grubbed and accepted as completed. Acreage will be determined from horizontal measurements.

(3) **Lump Sum Basis.** When "Grubbing" has been bid at a lump sum price the item shall include all necessary grubbing, as defined in this subsection, involved in the satisfactory completion of the project.

**10.14 BASIS OF PAYMENT.** (1) If there is some "Grubbing" work that should be performed, on the project, and there is no "Grubbing Item" in the proposal then it is understood and agreed that the necessary grubbing shall be done by the contractor, in accord with the provisions of this subsection, but that payment for the work shall be presumed to be included and absorbed by the prices bid for other items.

(2) This item, when included in the proposal, shall be paid for on the basis upon which it was bid, which price and payment will be full compensation for all labor, equipment, tools and incidentals necessary to complete the item.

Item Number	Item Description	Unit
1011	Grubbing	Acre
1012	Grubbing	Lump Sum

## SUBSECTION 10.20—CLEARING AND GRUBBING

**10.21 DESCRIPTION.** "Clearing and Grubbing" shall consist of clearing the ground of all trees, brush and rubbish within the limits designated for clearing and for doing the necessary grubbing, as hereinbefore provided in the Subsections 10.00 and 10.10, "Clearing" and "Grubbing," respectively.

**10.22 CONSTRUCTION METHODS.** The work shall be done in accordance with the provisions contained in Subsections 10.00 and 10.10, "Clearing" and "Grubbing," respectively.



**10.23 METHOD OF MEASUREMENT.** (1) **General.** The boundaries of the areas to be cleared and grubbed will be established by the engineer by the use of stakes, lath, flags or other satisfactory means.

(2) **Acre Basis.** When "Clearing and Grubbing" has been bid at a unit price per acre the acreage to be measured and paid for will be the number of acres, computed to the nearest hundredth, actually cleared and grubbed and accepted as complete. Acreage will be determined from horizontal measurements.

(3) **Lump Sum Basis.** If an item is included in the proposal calling for a lump sum price for all "Clearing and Grubbing," then no measurements for purposes of payment will be made other than those measurements necessary to determine whether or not the contractor has actually cleared and grubbed the specified areas.

**10.24 BASIS OF PAYMENT.** (1) If there is some "Clearing and Grubbing" work that should be performed, on the project, and there is no "Clearing and Grubbing Item" in the proposal then it is understood and agreed that the necessary clearing and grubbing shall be done by the contractor, in accord with the provisions of this subsection, but that payment for the work shall be presumed to be included and absorbed by the prices bid for other items.

(2) This item, when included in the proposal, shall be paid for on the basis upon which it was bid, which price and payment will be full compensation for all labor, equipment, tools and incidentals necessary to complete the item.

Item Number	Item Description	Unit
1021	Clearing and Grubbing	Acre
1022	Clearing and Grubbing	Lump Sum

## **SUBSECTION 10.30—ROADSIDE CLEAN-UP**

**10.31 DESCRIPTION.** (1) "Roadside Clean-up" shall consist of cleaning up roadside areas in accordance with this specification. The areas to be cleaned up shall be those areas so denoted on the plans and/or designated by the engineer, located in any case beyond the road prism slope lines.

(2) Clean-up shall consist of clearing the designated ground of down timber, dead brush, logs, and debris, the felling and destroying of such snags and dangerous trees, within the area designated to be cleaned and the burning of other disposal of the spoils, as ordered by the engineer. Clean-up shall also include the removal, from cultivated or cropped areas, of all dead plants and plant refuse and shall include living crop plants when so ordered by the engineer.

**10.32 CONSTRUCTION METHODS.** (1) The neatness of cleaning up shall be relative, so as to be in character with the surroundings. Hand raking or any similar exaggerated degree of treatment shall not be required.

(2) Intensity of clean-up shall be gradually diminished from the road prism construction outward to the clean-up limits or boundary designated by the engineer, so as to effect a natural transition in treatment, and so as to avoid sharp demarcation between the artificial and the natural.

(3) As a general guide, the first twenty (20) foot width nearest the roadway shall have practically all small sticks and other loose particles removed, except those of approximately one (1) inch or less in thickness or diameter. The second twenty (20) foot width shall be cleaned of substantially all sticks and loose particles exceeding approximately two (2) inches in thickness or diameter, and the third twenty (20) foot width shall be cleaned of substantially all sticks and loose particles exceeding approximately three (3) inches in thickness or diameter.

(4) Trees and snags designated for removal shall be cut flush with the ground. Stumps within the areas designated for clean-up also shall be cut flush with the ground.

(5) Refuse from clean-up operations shall be disposed of as provided under Subsection 10.00 "Clearing."

**10.33 METHOD OF MEASUREMENT.** The unit of measurement will be the acre or on a "lump sum" basis as set forth in the proposal form. In no case will any area within the road prism slope lines be included in the measurement for payment. The area to be paid for will be the number of acres, computed to the nearest hundredth, of land cleaned up as staked and ordered by the Engineer and in accordance with this specification. Acreage will be computed from dimensions measured horizontally.

**10.34 BASIS OF PAYMENT.** (1) If there is some "Roadside Clean-up" work that should be performed, on the project, and there is no "Roadside Clean-up Item" in the proposal then it is understood and agreed that the necessary roadside clean-up shall be done by the contractor, in accord with the provisions of this subsection, but that payment for the work shall be presumed to be included and absorbed by the prices bid for other items.

(2) This item, when included in the proposal, shall be paid for on the basis upon which it was bid, which price and payment will be full compensation for all labor, equipment, tools and incidentals necessary to complete the item, excepting any extra work of rehandling of spoils materials due to delayed burning, as ordered by the engineer, not made necessary by fault or negligence of the contractor.

Item Number	Item Description	Unit
1031	Roadside Clean-up	Acre
1032	Roadside Clean-up	Lump Sum





## SECTION 11

# EXCAVATION AND EMBANKMENT



**SUBSECTION 11.00—ROADWAY, DRAINAGE AND BORROW EXCAVATION.**

**11.01 DESCRIPTION.** Roadway, drainage and borrow excavation shall consist of excavating and satisfactorily disposing of all material of whatever character from the roadway prism and from those areas within the limits of the work, within or without the right of way, except as provided for structures; to construct, grade, shape, slope and finish, embankment, subgrade, shoulders, gutters, channels, waterways, inlet and outlet ditches of structures, interception, irrigation, offtake and intake ditches parallel to or adjoining the roadway, interseptions, roadway and structure approaches, berms, dikes and private entrances in the locations and to the elevations and forms shown on the plans and as directed by the engineer. It shall consist of backfilling ditches and depressions, rounding tops of slopes, removal and satisfacorty disposal of all unsuitable and surplus materials occurring within the limits of the work and all incidental work of whatsoever nature is required to construct the roadway and its earthwork appurtenances. The special provisions and/or the proposal shall prescribe the particular type or types of excavation involved in the project.

**11.02 CONSTRUCTION METHODS.** (1) **Grading.** Before ground is broken for excavation, all clearing and grubbing required shall have been performed on those areas in accordance with the specifications for that work. All suitable materials removed from the excavation shall be used insofar as practicable in the formation of the embankments, subgrade, shoulders, and at such other places as designated and/or directed by the engineer. All excavated material shall be disposed of as directed by the engineer and no payment will be made for any excavated material which is used for purpose other than those designated.

No material from borrow pits shall be used until it is determined that all "roadway and drainage excavation" can be utilized in the embankments. Borrow areas will be designated either on the plans or by the engineer. Material taken as borrow prior to being staked by the engineer will not be paid for.

When so directed, cuts shall be uniformly widened and slopes flattened, where necessary, to obtain additional excavation for embankments and/or to increase stability of slopes. When rock is encountered, where slopes will stand at a steeper slope than shown in the plans, the slopes shall be steepened as ordered by the engineer.

Where the ground foundation for embankments is composed of muck and/or other unstable materials such materials shall be removed to the depth shown on the plans and/or as directed by the engineer and satisfactorily disposed of. The excavated areas shall be backfilled with suitable material as directed.



The engineer may permit the use of excavated rock for other purposes than embankments, in which cases the contractor shall furnish and place, at his own expense, an amount of borrow, if required, equal to the deficiency caused by the rock being used elsewhere. Rock, hard sandstone, shale, or other solid unyielding materials, when encountered in cuts, shall be excavated to the depth indicated in the plans or to a minimum of 12 inches below subgrade and backfilled with acceptable material. Soft and spongy spots shall be excavated to the depth below subgrade as directed by the engineer.

When encountered, material suitable for backfill or road finishing purposes shall be excavated in such sequence that the material can be placed direct in final position on the top portion of the roadbed or as otherwise directed. When this cannot be accomplished and when so directed by the engineer, such suitable material shall be stockpiled for subsequent placing in final position as required.

During the construction of the roadway the roadbed shall be maintained in such a condition that it will be well drained at all times. Side ditches or gutters emptying from cuts to embankments shall be so constructed as to avoid damage to embankments by erosion. The contractor shall maintain, and keep open and free from leaves, sticks and other debris, all ditches constructed by him until final acceptance of the project.

(2) **Sloping.** The slopes of all cuts, ditches, embankments and all earthwork structures shall be constructed and dressed in a neat and workmanlike manner according to the plans or as directed by the engineer. Hand trimming will not be required where a neat uniform face is otherwise obtained. The slopes in all cuts and banks of borrow pits shall be trimmed from top to bottom in firm material and all loose material at the bottom of slopes shall be removed or blended in with the general work.

(3) **Shaping.** After all earthwork has been substantially completed, all structures are complete, and all drains are laid, the entire surface of the roadbed shall receive a finish shaping with a grading machine, supplemented by hand work where necessary, to secure a smooth surface and uniform cross section. Rock sections and all other sections, where the natural material is not considered suitable by the engineer, shall be brought to grade by depositing, to the depth authorized by the engineer, a satisfactory cushion of selected material.

(4) **Finishing.** The entire roadbed shall be brought to the final elevation and shape indicated on the plans and dressed as directed by the engineer. No roots, sod, or other deleterious matter shall be left within the top 4 inches of the finished subgrade surface. Oversize material, either loose or partly buried, that will not pass a 4-inch square screen shall be removed from the entire surface of the roadbed and shall be disposed of as directed. The finished grade shall not deviate

more than one-tenth foot at any point from the staked elevation and, provided further, that the sum of the deviations from true grade of any two points not more than 30 feet apart shall not exceed one-tenth foot.

In order to secure a smooth even surface to the finished subgrade the contractor shall use a self-propelled motor grader weighing not less than 20,000 pounds with a minimum blade length of not less than 12 feet.

**11.03 METHOD OF MEASUREMENT.** (1) Roadway, drainage and borrow excavation, unless otherwise specified, shall be classified as "Unclassified Excavation." All accepted roadway, drainage and borrow excavation shall be measured by the cubic yard in its original position by the method of average end areas. Measurement will include all slides not due to the carelessness of the contractor and authorized excavation of rock and soft spongy spots below grade or below original ground line of embankment areas. The measurement shall include unavoidable overbreakage in solid rock excavation to an amount not to exceed, in any half station of 50 feet, 10 per cent of the actual quantity required for the same half station within the lines shown on the plans.

(2) Roadway and drainage excavation used as selected material and/or stockpiled as such, shall be measured by the cubic yard in its original position as roadway and drainage excavation. When removed from the stockpile and placed as directed by the engineer, it shall again be included for measurement according to the volume in its original excavated position.

(3) Unless otherwise specified, "clearance of right of way" (Section 10) within the limits of the work shall be considered as incidental to and necessary to performance of roadway, drainage and borrow excavation and shall be performed at the contractor's sole expense.

**11.04 BASIS OF PAYMENT.** All accepted roadway, drainage and borrow excavation shall be paid for at the unit price bid per cubic yard for "Roadway, Drainage and Borrow Excavation," unless otherwise specified, which price and payment shall be full compensation for clearance of right of way, preparation, formation, sloping, shaping and finishing embankments, subgrades, shoulders and roadway and all other excavation within the limits of the work; disposal of surplus material, excavating below subgrade and embankment foundation areas, roadway and drainage excavation for selected material, rounding tops of slopes and shall include the furnishing of all labor, tools, equipment and incidentals necessary to complete the work in accordance with this specification.

Item Number	Item Description	Unit
1101	Unclassified Excavation & Borrow	Cubic Yard
1102	Unclassified Excavation & Borrow- Urban	Cubic Yard
1103	Unclassified Excavation & Borrow & Special Borrow	Cubic Yard
1104	Unclassified Excavation	Cubic Yard
1105	Special Excavation	Cubic Yard
1106	Trench Excavation	Cubic Yard
1107	Rock Excavation	Cubic Yard

### SUBSECTION 11.50—SPECIAL BORROW

**11.51 DESCRIPTION.** "Special Borrow" shall consist of the excavation and placing of materials obtained from accepted sources designated in the plans, stipulated in the proposal or from authorized supplementary sources. Generally, special borrow shall be placed in layers or courses immediately below subgrade surface on embankments and through cuts to such thickness as is specified in the plans and/or proposal.

**11.52 CONSTRUCTION METHODS.** Special borrow excavation shall be performed in accordance with pertinent provisions of Subsection 11.00, "Roadway, Drainage and Borrow Excavation." All material not suitable for special borrow shall be removed from the borrow area and disposed of as directed by the engineer. Placing of special borrow on roadway embankments and cuts shall be in conformance with the provisions of Subsection 11.80, Article 11.84, Method I, except as may be otherwise stipulated in the proposal or shown in the plans.

**11.53 METHODS OF MEASUREMENT.** (1) Special borrow, when specified, will be measured by the cubic yard in its original position by the method of average end areas unless otherwise stipulated in the proposal.

(2) Other items required of the work, when specified, will be measured by the unit stipulated in the proposal and by the method required of the pertinent specification section.

**11.54 BASIS OF PAYMENT.** (1) Special borrow will be paid for at the unit price bid for all special borrow used in the accepted and completed work, which price and payment will include all labor, tools, equipment and incidentals necessary to complete the work. No payment whatever will be allowed the contractor for removal and disposal of unsuitable materials from borrow areas, nor will payment be allowed for special borrow removed from areas prior to the staking and cross-sectioning thereof by the engineer.

(2) Other items specified will be paid for at the respective contract unit bid price, which price and payment will include all labor, tools, equipment and incidentals necessary to complete the work.

Item Number	Item Description	Unit
1151	Excavation—Special Borrow	Cubic Yard

## **SUBSECTION 11.60—EXCAVATION FOR CULVERTS AND RETAINING WALLS**

**11.61 DESCRIPTION.** "Excavation for Culverts and Retaining Walls" shall consist of all excavation for foundations for culverts, retaining walls, riprap, masonry and other minor structures and for excavation necessary for the removal of culverts from existing roadbeds and from other locations, and shall include the disposal of all material obtained from such excavation and backfilling to the level of the original ground. The special provisions and/or the proposal shall prescribe the particular type or types of excavation involved in the project.

**11.62 CONSTRUCTION METHODS.** All material excavated shall be unclassified and will be paid for as specified. The excavation lines and grades of culverts shown on the plans shall be considered as approximate only, and they may be ordered by the engineer to be placed at any elevation or location, or of any dimensions necessary to give a satisfactory foundation or to provide more suitable drainage and no additional compensation will be allowed for any such change except as provided for under "Basis of Payment." Boulders, logs, or any unforeseen obstacles encountered in excavating shall be removed and no additional compensation will be allowed for removing such obstructions.

**11.63—METHOD OF MEASUREMENT.** Excavation, unless otherwise specified, will be measured to the nearest one tenth (0.1) cubic yard in its original position removed in the completed and accepted work. Measurement will only include excavation bounded by the bottom planes as established and twelve (12) inches outside the neat lines of vertical planes, including ends, of all culverts, walls and/or other minor structures. Where forms are required, the measurement may include eighteen (18) inches outside the neat lines. For structural plate types, measurement may be extended to twenty-four (24) inches outside neat lines.

Culvert excavation shall include only that excavation which is removed below the final subgrade templet section of the roadway, except that in embankment sections, the original ground lines shall govern. If the contractor places culverts prior to the removal of the roadway excavation, he shall be paid culvert excavation only for that material which is removed below the final subgrade templet section.

**11.64 BASIS OF PAYMENT.** Excavation will be paid for at the contract unit bid price, which price and payment shall be full compensation and shall include furnishing all material, labor, tools, equipment and incidentals necessary to complete the work.



Item Number	Item Description	Unit
1161	Culvert Excavation	Cubic Yard
1162	Excavation for Riprap	Cubic Yard
1163	Excavation for Rubble Masonry	Cubic Yard
1164	Excavation for Retaining Walls	Cubic Yard

## SUBSECTION 11.70—DISPOSAL OF SURPLUS MATERIAL

**11.71 DESCRIPTION.** "Disposal of Surplus Material" shall consist of the disposal of all surplus excavated material including rocks brought to the surface by scarifying. The material shall be disposed of by widening embankments or by flattening slopes, or by depositing the material in such other places and for such other purposes as the engineer may direct. Large rocks brought to the surface by scarifying or otherwise, shall be disposed of in such manner that they will not be noticeable from the completed roadway.

The work described herein will not be measured or paid for directly. It shall be considered a necessary part of and incidental to the work involved of the other items of the contract.

\* \* \*

## SUBSECTION 11.80—EMBANKMENT

**11.81 DESCRIPTION.** "Embankment" shall consist of the construction of all roadway fills and dikes, placing of miscellaneous backfills, within or without the right of way, to the lines, grades, dimensions and typical section shown in the plans and/or as designated by the engineer and at those locations and to such revised widths, heights and dimensions as the engineer may consider necessary and/or to allow for settlement, consolidation and compaction of the embankment, the compacting of embankment foundation areas and the embankment material as it is being placed, all in accordance with the plans and these specifications.

**11.82 MATERIAL.** Suitable material shall be secured from designated roadway and drainage, structure, culvert or borrow excavation in conformity with the lines and grades and locations shown in the plans and/or as designated by the engineer. Stumps, trees, logs, rubbish, vegetation or other unsuitable materials shall not be placed in embankments. Sod mixed with surface soil and soil containing large amounts of humus or other organic materials shall, as far as practicable, be spread over the embankment slopes or incorporated in the embankments outside of the shoulder lines. Pockets of rocks and/or muck will not be permitted. Frozen material shall never be placed in embankments.



When an embankment is adjacent to or parallel to a stream or channel, rock encountered in excavation shall be used, as far as possible, to protect the slope by dumping and working the rock to the stream side of the fill.

**11.83 CONSTRUCTION METHODS. General.** When embankments are to be placed on a hillside, or where new fill is to be placed against existing embankments, or where the fill is to be constructed one-half width at a time, the slope of the original hillside, or old or new fill respectively, shall be benched or stepped by cutting into it horizontally, for a minimum distance of eighteen (18) inches to provide for secure bonding of the embankment while it is being brought up in layers. Each bench shall be cut as close to the one below as the slope of the ground will permit. Material thus cut out of the benches shall be incorporated into the new fill at the contractor's expense.

Where embankments are to be made and compacted on original hillside, old or new fill, the slopes of the original ground, or fill, except in the case of rock slopes, shall be plowed or benched before filling is commenced.

Where embankment is to be constructed on a previously bituminous-surfaced roadway, the old surface courses shall be scarified to the full depth of the surfacing in place in order to break the surface seal, to aerate the old surfacing material and provide for a bonding of the new embankment material to be placed. The old surfacing material shall be recompact prior to placing embankment material.

When embankment is to be constructed across low swampy ground that will not support the weight of hauling equipment the lower part of the fill may, if approved by the engineer, be constructed by dumping successive loads of material in uniformly distributed layers of a thickness not greater than necessary to support the hauling equipment while placing subsequent layers in the previously specified standard manner.

Whenever the surface of a cut or the site of an embankment is covered with snow or ice, sufficient to impair the stability of the work, the snow and ice must be removed and deposited beyond the slope stakes at the contractor's own expense. Work of this nature shall be completed at least 300 feet in advance of the excavation and placing of the embankment material. Frozen excavation or that lying under a blanket of snow of such extent as to preclude its placement in the embankment, will be considered cause for shutting down grading operations.

If it should become necessary, because of weather or other conditions, to suspend grading operations the entire area worked upon shall be bladed smooth, free of depressions and ruts and crowned so that no water can collect or be impounded on the roadway.

Embankment constructed to grade and cross section during the winter shall be refinished to grade and cross section after the frost is out of the ground and the embankment is in suitable condition for this work.

Embankment placed adjacent to structures and for a distance of ten (10) feet therefrom, shall be brought up in equal layers on all sides of the timbers or trestles, or bulkheads, columns, or around small structures or culverts to prevent distortion of any of the structure members of structures or culverts. Areas inaccessible to rollers shall be compacted by mechanical tampers or other means until the density conforms to that specified under Article 11.86 of this subsection, provided however, that for embankment other than at structures, the compaction required shall not exceed that of the adjacent embankment, compacted in accordance with these specifications.

Embankment material shall be placed and compacted in accordance with one, or a combination of two, of the Methods prescribed in Articles 11.84, 11.85 or 11.86. Methods I and II will govern the construction of embankment dependent upon the type of excavation material being placed in the fill unless otherwise specified.

**11.84 METHOD I.** The material shall be placed in uniform approximately horizontal layers not to exceed eight (8) inches in loose thickness, for the entire width of the embankment and not less than three hundred (300) feet in length or for the entire length of the embankment. Each layer of embankment shall be completed, leveled and compacted before the succeeding layer is placed.

Material shall be spread, manipulated and kept leveled by means of a power grader weighing not less than twenty-thousand (20,000) pounds, with a minimum blade length of twelve (12) feet and/or a tractor angle or bull dozer combination weighing not less than twenty-thousand (20,000) pounds with a minimum blade length of ten (10) feet.

Levelling equipment of the kind specified shall be kept in continuous operation at all times the embankment is being constructed for the purpose of spreading and manipulating the material in blending it to uniform character, levelling and compacting it as it is placed in the embankment. Hauling equipment shall be routed to distribute travel over the entire area of each layer of material and over the entire width of the embankment being constructed and separate pieces of equipment shall not follow in the immediate tracks of preceding equipment. The embankment surface is to be kept level and uniform at all times. The sides of the embankment shall be constructed first and the center shall be brought up level with the shoulders.

Embankment material shall not be placed when the moisture incorporated in, or existing in, any layer causes excessive rutting by hauling equipment or when such moisture precludes proper compaction. Embankments rendered unstable by excessive amounts of moisture from any cause shall be dried by scarifying and blading the affected areas before placing succeeding layers.

When specified, compaction shall meet the density requirements set forth in Method III, Article 11.86.

When "watering" is specified, water shall be applied in the amounts, and over the areas and at the times, while embankment material is being placed, as designated by the engineer. When specified, "rolling" shall be accomplished in accordance with the provisions of Section 14, "Rolling," on the areas designated by the engineer, while the embankment material is being placed.

**11.85 METHOD II.** Embankments formed of material containing by volume twenty-five (25) per cent or more of rock larger than six (6) inches in diameter shall be placed in layers of sufficient depth to contain the maximum size or rock present in the material; provided, however, that in no case shall the thickness of layers before compaction exceed twenty-four (24) inches. Material containing rock shall be deposited on the material being compacted and spread over the preceding layers by dozers or other specified levelling equipment and the interstices shall be filled with finer material to form a dense compact mass. Even though the general thickness of layers is limited, the placing of individual rocks and boulders of a size not exceeding forty-eight (48) inches in least dimension will be permitted, provided they are carefully distributed and the interstices filled to form a dense compact mass. Except for the provisions herein referred to describing the thickness of layers permitted to be placed, placing of embankment material under Method II shall conform to the provisions of Method I, Article 11.84.

**11.86 METHOD III.** When shown in the plans or stipulated in the proposal, embankments shall be constructed in accordance with the following requirements. Material shall be placed as required under Method I, except that the maximum thickness of each layer shall contain only that amount of material which can be compacted to the specified density with the equipment used, in case the material contains less than twenty-five (25) per cent of rock larger than six (6) inches in greatest dimension then no layer shall exceed eight (8) inches in loose depth. Each layer of embankment material shall be disced or harrowed sufficiently to break down clods over six (6) inches in their greatest dimension, to thoroughly mix the various materials and to secure a uniform moisture content. Each such layer shall be carefully leveled to a designated thickness before compacting so as to insure uniform and proper compaction.

Compaction of embankments, including backfilling and preparation of embankment foundation areas to three (3) feet outside the toe of embankments shall be accomplished by whatever equipment is necessary and at such moisture content as is required to provide the density hereinafter specified, as determined by tests, while the embankment material is being placed. The compactive effort required to obtain the specified density is dependent, within certain limits, upon the moisture content of the material and the control thereof.

Where embankments three (3) feet or less in height are to be placed on soils having a relative compaction of less than ninety (90) per cent as determined by A.A.S.H.O. Method T-99, and/or equivalent methods, the ground surface shall be scarified, watered and rolled before placing embankment material until a relative compaction of at least ninety (90) per cent is reached in the upper eight (8) inches of the compacted soil. Should lightly compacted soils be encountered that extend to depths greater than eight (8) inches, the upper portion thereof, to a width equal to the width of the roadbed plus 1:1 supporting slopes, shall be removed to the depth ordered by the engineer, after which the ground surface shall be compacted until a relative compaction of ninety (90) percent is reached in the upper eight (8) inches. Material removed as herein provided shall be placed in embankment directly from excavation as directed by the engineer, or it may be placed alongside the trench and replaced therein after compaction operations have been completed within the excavated area. The material in the top eight (8) inches of the subgrade in cuts shall be compacted to the same density as that in adjoining embankments.

Full compensation for compacting the ground surface as specified shall be considered as included in the price paid per cubic yard for roadway excavation. The removal of lightly compacted soil, and the placing of it in embankment at other locations or the replacing of the material in the trench after compaction operations have been completed will be paid for as roadway excavation. Should the contractor elect to place the excavated material alongside the trench and replace the material after compaction operations have been completed, no allowance in pay quantities will be made for replacing the material, full compensation for such work being considered as included in the price paid per cubic yard for removal of the material as roadway excavation.

Embankment material which does not contain sufficient moisture to compact in accordance with the above requirement shall be sprinkled with water in accordance with the directions of the engineer, either during excavation or when being placed in embankment. Material containing an excess of moisture shall be permitted to dry to the proper consistency before being compacted.

Unless otherwise specified, each layer of embankment shall be compacted until the density of compacted material in the embankment shall be not less than the percentage of the minimum density shown in the following table in accordance with the minimum field compaction requirements of the A. A. S. H. O. Specification M-57.



Standard of Compaction or Maximum Density Obtained by A.A.S.H.O. Method T-99 and/or Equivalent Methods Lbs. per cu. ft.		Minimum Compaction Required, Per cent of Maximum Density
90- 99.9		100
100-109.9		95
110-119.9		95
120-129.9		90
130 and above		90

**11.87 METHOD OF MEASUREMENT.** Embankment construction will not be measured directly for payment but shall be considered subsidiary to and necessary of all excavated material required to construct roadway fills, embankment, dikes and backfill.

When stipulated in the proposal "watering" and "rolling" required under Method I shall be measured according to the unit bid.

Watering, rolling and other compactive effort required under Method III will not be measured but will be considered included in the price bid for unclassified excavation.

**11.87 BASIS OF PAYMENT.** Embankment construction will not be paid for directly but shall be considered a necessary part of the work, and included in the unit price bid for all excavation required to construct the embankment which prices and payments shall include all labor, tools, equipment and incidentals necessary to placing, levelling, manipulating, drying embankment material, plowing hillsides, cutting into old fills and scarifying old roadway surfaces and all cost incidental to completing the work in accordance with these specifications.

When stipulated in the proposal "rolling" and "watering" required under Method I will be paid for at the contract unit bid price in accordance with Sections 14 and 15, "Rolling" and "Watering," respectively.

Watering, rolling and other compactive effort required under Method III shall not be paid for separately but shall be considered incidental and necessary to compaction of the embankment and included in the payment for unclassified roadway and drainage excavation.





## SECTION 12

### OVERHAUL



**12.01 DESCRIPTION.** If, in the disposition and placement of materials excavated under the provisions of Section 11, it is necessary that the material be hauled more than one thousand (1,000) feet, "Overhaul" will be measured and paid for on such material when so provided by the proposal.

**12.02 METHOD OF MEASUREMENT.** The overhaul distance will be the distance between the centers of volume of overhaul material in (a) its original position and (b) after placing—less one thousand (1,000) feet. The distance shall be measured along the shortest practicable route as determined by the engineer. The number of units of overhaul shall be the product of the volume, in cubic yards, of the overhauled material, by the net overhaul distance in feet (a) divided by one hundred (100), if payment is made on a station yard basis and (b) divided by five thousand two hundred eighty (5,280) if payment is made on a mile yard basis.

**12.03 BASIS OF PAYMENT.** Overhaul when so provided by the proposal, will be paid for at the contract unit bid price, which price and payment will be full compensation for all labor, tools, equipment, manipulations and incidentals necessary to complete the work.

When not stipulated, by the proposal, overhaul of material will not be paid for directly but shall be considered incidental and necessary to the performance of and payment for the other contract items and shall include all labor, tools, equipment, manipulations and all incidentals necessary to complete the work.

Item Number	Item Description	Unit
1201	Overhaul of Unclassified Excavation and Borrow	Station Yard
1251	Overhaul of Unclassified Excavation and Borrow	Mile Yard
1202	Overhaul of Unclassified Excavation and Borrow—Urban	Station Yard
1252	Overhaul of Unclassified Excavation and Borrow—Urban	Mile Yard
1203	Overhaul of Unclassified Excavation and Borrow and Special Borrow	Station Yard
1253	Overhaul of Unclassified Excavation and Borrow and Special Borrow	Mile Yard
1204	Overhaul of Unclassified Excavation	Station Yard
1254	Overhaul of Unclassified Excavation	Mile Yard
1205	Overhaul of Special Excavation	Station Yard
1255	Overhaul of Special Excavation	Mile Yard
1206	Overhaul of Trench Excavation	Station Yard
1256	Overhaul of Trench Excavation	Mile Yard
1207	Overhaul of Rock Excavation	Station Yard
1257	Overhaul of Rock Excavation	Mile Yard
1208	Overhaul of Binder	Station Yard
1258	Overhaul of Binder	Mile Yard
1209	Overhaul of Filler	Station Yard
1259	Overhaul of Filler	Mile Yard



## SECTION 13

HAUL



**13.01 DESCRIPTION.** When so provided by the proposal, haul will be paid for the transporting of various surfacing materials.

**13.02 METHOD OF MEASUREMENT.** Haul will be the number of ton miles or yard miles determined by multiplying the number of tons or cubic yards, as the case may be, of accepted material by the distance hauled in miles and fraction thereof. The haul distance will be measured to the nearest one-tenth (0.10) mile along the shortest practicable route, as determined by the engineer, from loading point to the point of deposition. If the contractor chooses to haul the material over some other route, and such route is longer, the computation for payment shall be based on the haul distance measured along the route designated by the engineer.

**13.03 BASIS OF PAYMENT.** Haul, when so provided by the proposal, will be paid for at the contract unit bid price, which price and payment will be full compensation for all labor, tools, equipment, manipulations and incidentals necessary to complete the work.

When not stipulated by the proposal, haul of material will not be paid for directly, but shall be considered incidental and necessary to the performance of and payment for the other contract items and shall include all labor, tools, equipment, manipulations and all incidentals necessary to complete the work.

The proposal designates which of the following methods, if any, is to be followed:

Item Description	Unit	Item No.	Unit	Item No.
Haul of Selected Surfacing 4" max.	Ton Mile	1301	Yard Mile	1351
Haul of Selected Surfacing 3" max.	Ton Mile	1302	Yard Mile	1352
Haul of Selected Surfacing 2" max.	Ton Mile	1303	Yard Mile	1353
Haul of Selected Surfacing 1" max.	Ton Mile	1304	Yard Mile	1354
Haul of Sand Material Grade 1	Ton Mile	1305	Yard Mile	1355
Haul of Sand Material Grade 2	Ton Mile	1306	Yard Mile	1356
Haul of Sand Material Grade 3	Ton Mile	1307	Yard Mile	1357
Haul of Sand Material Grade 4	Ton Mile	1308	Yard Mile	1358
Haul of Selected Borr. Base Course Grade 1	Ton Mile	1309	Yard Mile	1359
Haul of Selected Borr. Base Course Grade 2	Ton Mile	1310	Yard Mile	1360
Haul of Selected Borr. Base Course Grade 3	Ton Mile	1311	Yard Mile	1361
Haul of Selected Borr. Base Course Grade 4	Ton Mile	1312	Yard Mile	1362
Haul of Selected Borr. Base Course Grade 5	Ton Mile	1313	Yard Mile	1363
Haul of Selected Borr. Base Course Grade 6	Ton Mile	1314	Yard Mile	1364
Haul of Crushed Base Course Grade 1	Ton Mile	1315	Yard Mile	1365
Haul of Crushed Base Course Grade 2	Ton Mile	1316	Yard Mile	1366
Haul of Crushed Base Course Grade 3	Ton Mile	1317	Yard Mile	1367
Haul of Crushed Base Course Grade 4	Ton Mile	1318	Yard Mile	1368
Haul of Crushed Base Course Grade 5	Ton Mile	1319	Yard Mile	1369
Haul of Type 'A' Top Surfacing Grade 1	Ton Mile	1320	Yard Mile	1370
Haul of Type 'A' Top Surfacing Grade 2	Ton Mile	1321	Yard Mile	1371
Haul of Type 'A' Top Surfacing Grade 3	Ton Mile	1322	Yard Mile	1372



ITEM DESCRIPTION			Unit	Item No.	Unit	Item No.
Haul of Type 'A' Top Surfacing	Grade 4	Ton	Mile	1323	Yard	Mile
Haul of Type 'A' Top Surfacing	Grade 5	Ton	Mile	1324	Yard	Mile
Haul of Type 'B' Top Surfacing	Grade 1	Ton	Mile	1325	Yard	Mile
Haul of Type 'B' Top Surfacing	Grade 2	Ton	Mile	1326	Yard	Mile
Haul of Type 'B' Top Surfacing	Grade 3	Ton	Mile	1327	Yard	Mile
Haul of Crushed Cover Aggregate	Grade 1	Ton	Mile	1328	Yard	Mile
Haul of Crushed Cover Aggregate	Grade 2	Ton	Mile	1329	Yard	Mile
Haul of Crushed Cover Aggregate	Grade 3	Ton	Mile	1330	Yard	Mile
Haul of Stone Chips	Grade 1	Ton	Mile	1331	Yard	Mile
Haul of Stone Chips	Grade 2	Ton	Mile	1332	Yard	Mile
Haul of Stone Chips	Grade 3	Ton	Mile	1333	Yard	Mile
Haul of Binder		Ton	Mile	1334	Yard	Mile
Haul of Filler		Ton	Mile	1335	Yard	Mile
Haul of Stockpiled Selected Surfacing		Ton	Mile	1336	Yard	Mile
Haul of Stockpiled S. B. B. C.		Ton	Mile	1337	Yard	Mile
Haul of Stockpiled Crushed Base		Ton	Mile	1338	Yard	Mile
Haul of Stockpiled Type 'A' Top Surfacing		Ton	Mile	1339	Yard	Mile
Haul of Stockpiled Type 'B' Top Surfacing		Ton	Mile	1340	Yard	Mile
Haul of Stockpiled Crushed Cover Aggregate		Ton	Mile	1341	Yard	Mile
Haul of Stockpiled Stone Chips		Ton	Mile	1342	Yard	Mile
Haul of Top Soil		Ton	Mile	1343	Yard	Mile
Haul of Stockpiled Top Soil		Ton	Mile	1344	Yard	Mile



## SECTION 14

### ROLLING



**14.01 DESCRIPTION.** "Rolling" shall consist of the operation of the various specified types of rollers as required for compaction of embankments, subgrade, aggregate surfacing, bituminous courses and cover aggregate, in conformity with these requirements and the specifications for the particular type of work involved.

**14.02 EQUIPMENT.** The types of rollers specified for the particular work shall conform to the following general requirements:

Weights of the rollers shall be based on the manufacturer's rating or recommendation.

Self-propelled rollers shall be powered adequately for the efficient accomplishment of the specified work and capable of reversible operation, devoid of back lash. They shall be in good mechanical condition and provided with positive accurate steering control. Pull type rollers shall be towed with truck or tractor power capable of efficient operation.

Roller operation shall be separate and distinct and, other than with required traction units, rollers shall not be operated in combination with any other equipment.

All types of rollers shall be equipped with such self-cleaning devices as are necessary to prevent adhesion of materials to the wheels or tamping surfaces.

**(a) Metal Wheeled Power Rollers.** Shall be smooth wheeled and self-propelled.

1. Tandem type weighing not less than five (5) tons or more than ten (10) tons.
2. Tandem type weighing not less than eight (8) tons.
3. Three wheeled type weighing not less than ten (10) tons.

**(b) Tamping Rollers.** Tamping rollers shall consist of metal rollers, drums or shells, surmounted by metal studs with tamping feet projecting not less than seven (7) inches from the surface of the roller, drum or shell. Tamping feet shall be spaced not less than six (6) inches or more than ten (10) inches, measured from center to center in any direction. The cross sectional area of each tamping foot, measured perpendicularly to the axis of the stud, shall not be less than four (4) nor more than twelve (12) square inches.

The weight of the tamping roller shall be such that the load on each tamping foot shall be not less than two-hundred (200) pounds per square inch of cross sectional area. The load per tamping foot will be determined by dividing the total weight of the roller by the number of tamping feet in one (1) row parallel to, or approximately parallel to, the axis of the roller. Each tamping roller shall consist of not less than two (2) sections and the length of each section shall be not less than four (4) feet.

(c) **Pneumatic-Tired Rollers.** Pneumatic-tired rollers shall be of the two-axle type, straight or oscillating, mounted in a rigid frame and provided with a platform or body suitable for ballast loading and having an effective rolling width of not less than four (4) feet. Under working conditions, unless otherwise specified, a pneumatic-tired roller shall have a minimum working weight capacity of two-hundred (200) pounds per inch width of tire tread.

The tires shall be smooth (no tread) and of equal size and diameter. The tires on the rear axle shall be so spaced that the entire tread gap of the preceding two (2) tires will be covered by the tread of the following tire. They shall be uniformly inflated and the air pressure in the several tires shall not vary from each other more than five (5) pounds per square inch.

The roller shall be capable of turning in such manner that the material being rolled or the adjacent roadbed shall not become dislodged or loosened. Depending upon specifications for the particular type work, the roller may be self-propelled or drawn by either suitable tractor or truck of adequate tractive power.

Use of wobble wheel pneumatic-tired rollers will not be permitted on bituminous surfacing work.

(d) **Other Types of Rollers.** Use of other types of rollers of recent design or invention and heretofore not described shall require the prior approval of the engineer.

**14.03 CONSTRUCTION METHODS.** (a) **General.** Each layer of a surface course or each layer of embankment where compaction is required shall be completely compacted by rolling and/or watering before the succeeding course or layer is placed.

Rolling shall be extended completely across the roadway, commencing at the sides and progressing toward the center, overlapping each preceding passage by approximately one-half ( $\frac{1}{2}$ ) the width of the roller. On super-elevated curves, rolling shall begin at the low side and progress toward the high side. Rollers shall operate at a nominal speed of between two (2) and three (3) miles per hour.

Rolling shall be continued until the required compaction has been secured. The amount of rolling and watering on any type of work shall be determined exclusively by the engineer.

Along curbs, headers and walls and at all places not accessible to the rollers the area on any type of surface shall be compacted thoroughly with acceptable mechanical or hand tampers. Each hand tamper shall weigh not less than fifty (50) pounds and have a surface area of not more than one-hundred (100) square inches.

**(b) Compaction of Embankment.** Where compaction of embankment by rolling is specified, the rollers used shall be of the type described in Paragraph (b) of Article 14.02 in accordance with requirements of Subsection 11.80, embankment.

**(c) Compaction of Aggregate Surfacing.** Compaction on any of these respective types of work shall be accomplished through an operation which coordinates use of the type of rollers specified in Paragraph (a)—Types 2 and 3—and Paragraph (c) of Article 14.02, as required in obtaining specified results.

Rolling shall commence with the initial blade layout of spreading each layer of surfacing material following its being completely mixed and blended and shall be carried on concurrently with the spreading process of the layer. No less than three (3) complete passages of a roller of any type shall be required and rolling shall be continued until the surface is smooth and unyielding.

The amount of rolling and watering required shall be determined by the engineer. Each layer placed shall be bladed smooth and thoroughly compacted by rolling and watering before the succeeding layer is placed. The methods herein described shall be applied to placing each successive layer.

Blading, rolling and watering shall be performed alternately, as required or directed, until the resulting product is a smooth, even, uniformly compacted surface acceptable and ready for placement of a succeeding surfacing course.

**(d) Compaction of Subgrade.** Equipment and methods used for compaction of subgrades shall be the same as employed on aggregate surfacing, with the methods being modified in accord with the conditions encountered but resulting in the degree of compaction specified by Subsection 11.80.

**(e) Compaction of Bituminous Surfacing.**

1. Road Mix—See Section 34.
2. Plant Mix—See Section 35.
3. Bituminous Surface Treatment and Seal Coat—See Sections 33 and 36, respectively.

**14.04 METHOD OF MEASUREMENT.** Rolling will be measured in units determined on the basis of the compacting width of roller of six (6) feet and the hours of time actually consumed in rolling. The rolling units will be computed, therefore, by multiplying the time in hours actually consumed in rolling by the effective rolling width of the roller, in feet, and dividing the product by six (6). Time consumed in servicing or repairing the roller or in moving to and from the point where the work is to be done, will not be measured. When specified as being necessary, but not included in the proposal as a bid item, rolling will not be measured directly but shall be considered incidental to the performance of the other items of the contract.



**14.05 BASIS OF PAYMENT.** Rolling used in the completed and accepted work will be paid for at the contract unit bid price, which price and payment, except as otherwise expressly provided, will be full compensation for all materials, labor, equipment, tools and incidentals necessary to complete the work.

When specified as being necessary, but not included in the proposal as a bid item, rolling will not be paid for directly but shall be included in the payment for the other items of the contract.

Item Number	Item Description	Unit
1401	Rolling Embankment	Unit
1402	Rolling Subgrade	Unit
1403	Rolling Aggregate Surface Courses	Unit
1404	Rolling Road Mix Bituminous Surface	Unit
1405	Rolling Bituminous Surface Treatment	Unit
1406	Rolling Seal Coat	Unit





## SECTION 15

### WATERING



**15.01 DESCRIPTION.** "Watering" shall consist of furnishing and applying water as required in the compaction of embankments, subgrades, aggregate surfacing materials, and wetting cover or chip material, in accordance with the requirements of these specifications.

**15.02 CONSTRUCTION METHODS.** (a) **Watering Embankments and Surfacing Aggregates.** Water, when required, shall be applied on the areas and in the amounts and at the times directed by the Engineer. The contractor shall furnish and operate equipment, for applying water, consisting of tanks equipped with spray bars and pumps to operate under pressure. They shall be mounted on pneumatic-tired trucks or pneumatic-tired trailers pulled by pneumatic-tired equipment. The minimum capacity of any water distributing tank shall be one-thousand (1,000) gallons. The water distributing equipment shall be constructed to permit accurate and uniform distribution of the required rates of water per unit of surface area. The control valves shall be constructed to permit positive closing and to prevent leakage.

Sufficient equipment shall be available at all times to apply the amount of water required within the time interval necessary to secure proper results before evaporation, absorption, or drainage prevents or interferes with the required results. When directed by the engineer, watering may be done at night or at other times to minimize losses by evaporation, absorption or drainage.

(b) **Watering Cover Material.** When watering of cover or stone chips material is stipulated in the proposal, the contractor shall furnish facilities adequate to the work required. Watering of cover or stone chip material shall be performed in the truck after weighing.

**15.03 METHODS OF MEASUREMENT.** (1) Watering will be measured by the number of one-thousand (1,000) gallon units as ordered, measured in the vehicle at the point of delivery on the road. Measuring may be done by a meter of an approved type, or manual count of the number of loads delivered or as counted by an approved type of a load counter affixed to the vehicle. All equipment for measuring, such as a meter or load counter, shall be furnished and installed by, and at the expense of, the contractor.

(2) If the proposal stipulates that the unit of watering is by the hour, the units to be paid for shall be the number of hours counted to the nearest half-hour required by application to the cover or chip material.

**15.04 BASIS OF PAYMENT.** The accepted quantities of this item shall be paid for at the unit bid price bid per one-thousand (1,000) gallon unit or per hour, as stipulated in the proposal, which price and payment shall be full compensation for furnishing, hauling and applying, and for all labor, equipment, tools and incidentals necessary to complete the item. When the proposal does not stipulate an item of "Furnishing

and Maintaining Water Plant," the performance of this item shall be considered incidental to and included in the other items of the contract.

When stipulated in the proposal, the item, "Furnishing and Maintaining Water Plant," shall be paid for at the lump sum bid. No payment shall be made for the latter unless installation is authorized in writing by the engineer.

Water used in surface cleaning preparatory to placing a subsequent course of bituminous surfacing or cover material will not be paid for separately but shall be considered incidental to and included in payment for the other items of the contract.

Watering will be paid for, if so specified, by one or more of the items listed below.

Item Number	Item Description	Unit
1501	Furnishing and Maintaining Water Plant	Lump Sum
1502	Watering Embankment	M. Gallons
1503	Watering Subgrade	M. Gallons
1504	Watering Surfacing Courses	M. Gallons
1505	Watering Cover Material	Hour
1506	Watering Stone Chips	Hour







**SECTION 16**  
**CONTINGENT CONSTRUCTION AND**  
**OPERATIONS**



**SUBSECTION 16.00 EQUIPMENT USE**

**16.01 DESCRIPTION.** "Equipment use" shall consist of the furnishing, by the contractor, for use on the project and for performance of work specified and/or directed by the engineer, any of the units of equipment herein described, when indicated by the plans and/or stipulated in the proposal.

**16.02 EQUIPMENT. General Requirements.** Any equipment furnished shall be in good mechanical condition and shall have sufficient motive power for successful continuous performance of the assigned work. Any equipment not capable of meeting these requirements will not be permitted on the work.

(a) **Motor Grader.** The motor grader shall be self-propelled and shall weight not less than twenty-thousand (20,000) pounds. It shall be equipped with a standard mold-board, not less than twelve (12) feet in length, with suitable cutting edge, a scarifier standard to the unit, complete with suitable teeth, all positive power controlled.

(b) **Dozer.** The dozer may be either the angle or straight dozer type, not less than eleven (11) feet in length, with suitable cutting edge, power unit controlled, attached to a tractor weighing not less than thirty-thousand (30,000) pounds with sufficient power to provide efficient operation. The dozer and tractor shall be considered as a single unit.

(c) **Shovel or Dragline.** This unit shall be the full revolving type equipped with either a dragline or shovel bucket, as the work may require, of not less than one-half ( $\frac{1}{2}$ ) cubic yard manufacturer's rated capacity. In no case shall the bucket be larger than that for which the machine was designed. If work conditions require, the unit shall include a set of suitable track bearing mats.

(d) **Scraper.** The scraper shall be of the pneumatic-tired carryall type, standard to a twelve (12) cubic yard truck load capacity, supplied with tractive power adequate to its efficient loading capacity performance.

(e) **Tractor-Loader.** The tractor-loader shall be the front end, one (1) cubic yard bucket type, with full power control mounted on either a wheel or crawler tractor.

(f) **Chip Spreader.** This unit shall be self-propelled and rubber mounted.

**16.03 METHOD OF MEASUREMENT.** Equipment use will be measured by the hour, for the use of any unit specified, for its actual use in the performance of the assigned work. Time consumed in moving equipment from point to point on the project and for repairing and servicing will not be measured.

Measurement of the respective excavating loading unit hours will be adjusted up or down from the specified standard load capacity to reflect the actual efficient load performance capacity with the motive power necessary. Adjustment will be based on a direct capacity bid price ratio.

**16.04 BASIS OF PAYMENT.** Equipment use will be paid for at the unit price bid per hour for the unit, when stipulated in the proposal, which price and payment shall include furnishing the equipment on the project in completely operable condition, including operator, servicing, repairs and all incidentals necessary to the accepted work performance as herein specified and assigned.

Item Number	Item Description	Unit
1601	Use of Motor Grader	Hour
1602	Use of Dozer	Hour
1603	Use of Shovel or Dragline	Hour
1604	Use of Scraper	Hour
1605	Use of Tractor-Loader	Hour
1606	Use of Chip Spreader	Hour

## **SUBSECTION 16.10 EXISTING SURFACE PREPARATION**

## **SUBSECTION 16.20 EXISTING SURFACE REMOVAL**

**16.11 DESCRIPTION.** "Existing Surface Preparation" shall consist of reshaping, to the typical section, and truing the grade line of a previously completed earth subgrade section and/or gravel or bituminous surfaced roadbed, as the case may be, in preparation for the immediate construction of new surfacing as required by the specifications and plans.

**16.21 "EXISTING SURFACE REMOVAL"** shall consist of the removing and disposal of the existing surface from the areas and to the depth required by the specifications and plans and/or as directed by the engineer.

**16.12 and 16.22 CONSTRUCTION METHODS.** This work shall be accomplished in accordance with one of the methods herein described and as required by the plans for the particular type of new surfacing and/or by the method stipulated in the proposal.

**16.12 EXISTING SURFACE PREPARATION. (a) Subgrade.** All soft and unstable areas in the subgrade shall be excavated, the undesirable material removed from the roadway and the excavations backfilled with material satisfactory to the engineer. Holes and depressions which cannot be brought to true line and grade by blading shall be filled with suitable material, as directed.

The entire subgrade surface shall be bladed to true line and grade, and in conformance with the typical section, with motor graders conforming to the provisions of Subsection 16.00. Roadway ditches shall be bladed clean and maintained

for effective drainage. Shoulder lines shall be trued and roadway slopes shall be shaped and sloped to a point below the shoulder, consistent with the toe of the inslope elevation, to present a general uniform appearance of the work as required by the plans. After final blading, the surface shall be watered and compacted in accordance with the requirements of the respective specifications. It shall be maintained by the contractor, in the reconstructed condition, until the surfacing is placed.

**(b) Aggregate Surfaces.** Equipment, methods of work performance and general requirements for aggregate surfacing preparation are essentially identical with those specified in Article 16.12 (a). When the aggregate surface is to be applied with any type of bituminous surface, the surface shall be prepared in accordance with the requirements thereof. Any rocks or other similar objects protruding through the surface shall be removed and satisfactory repairs effected.

**(c) Bituminous Surface.** If the surface on which any surfacing material is to be placed is an existing bituminous surface such surface shall be removed or left in place as stipulated in the proposal and/or shown on the plans. If removal is indicated, the existing surface shall be scarified, broken up and disposed of as directed by the engineer.

If the bituminous surface is to be left in place, the surface shall be prepared as follows: Where the existing bituminous surface or bituminous patches show an excess of bituminous material, and where bituminous surfacing material has been placed over major settlements in the subgrade, the bituminous surfacing material shall be removed or reworked and satisfactorily stabilized as directed by the engineer. Where the existing bituminous surface is corrugated, due to excessive amounts of moisture in the underlying surface courses or the subgrade, the unsuitable material shall be removed and the subgrade stabilized by drying and the surface material reworked and relayed or replaced as directed by the engineer. When unsuitable materials are removed entirely, the affected areas shall be brought up to grade and typical section by backfilling with surfacing material as specified. These areas shall be satisfactorily compacted by watering and rolling and a prime coat of bituminous material applied to the final surface.

Immediately prior to placing any bituminous levelling material, course or courses the existing surface shall be thoroughly cleaned of dirt and loose or extraneous material by means of power brooms, hand brooming, water washing and/or other methods necessary to accomplish satisfactory results. If stipulated in the proposal, or directed by the engineer, a prime or tack coat of bituminous material shall be applied to the cleaned surface in the amounts and over the areas as directed by the engineer.

When stipulated in the proposal, or directed by the engineer, levelling material of the kind of premixed bituminous surfacing specified shall be spread in compacted layers not



to exceed two (2) inches or a total thickness exceeding six (6) inches, as is necessary to level irregularities, dips, depressions, sags and excessive crown and to provide a smooth base of uniform grade and in conformance to the typical section in order that the subsequent surface course or courses of bituminous surfacing shall be of uniform thickness. When such corrections exceed six (6) inches in depth, specified aggregate surfacing material shall be used. If plant mixed bituminous surfacing is spread as the levelling material, it will be paid for at the unit price bid for plant mix bituminous surfacing and no additional allowance will be made for spreading, levelling and rolling.

**16.22 EXISTING SURFACE REMOVAL.** This type of work shall be accomplished by any equipment equal to the job and satisfactory to the engineer. The surface, after removal, shall be prepared to receive any new surfacing material in the same manner applicable as described in Article 16.12.

**16.13 and 16.23 METHOD OF MEASUREMENT.** "Existing Surface Preparation" or "Existing Surface Removal" may be measured by the mile or by the station, calculated along the centerline of the roadway, by the square yard of area and/or by the equipment unit hour, as stipulated in the proposal and/or shown in the plans. When not stipulated in the proposal as an item, work required of "Existing Surface Preparation" or "Existing Surface Removal" will not be measured directly but shall be considered necessary and incidental to the performance of the other items of the contract.

All materials, aggregate, surfacing course aggregate, bituminous material, bituminous mixed surfacing spread as the levelling material, watering and rolling, except rolling on any plant mix bituminous surfacing, used in the completed and accepted work for corrective purposes in "existing surface preparation" will be measured by the unit indicated in the proposal, pertinent to the class of work performed.

**16.14 and 16.24 BASIS OF PAYMENT.** "Existing Surface Preparation" or "Existing Surface Removal" will be paid for at the unit bid price or prices stipulated in the proposal, which prices and payment shall be full compensation for the respective bid units and shall include all labor, tools, equipment and incidentals necessary to complete the work. If not stipulated in the proposal, work required of "Existing Surface Preparation" or "Existing Surface Removal" will not be paid for directly but will be considered incidental to the payment for and the performance of the other items of the contract, which payment shall be full compensation for all labor, tools, equipment and incidentals necessary to complete the work in acceptable manner.

All materials, aggregate, surfacing course aggregate, bituminous material or bituminous mixed surfacing spread as the levelling material, watering and rolling, except rolling

on any plant mix bituminous surfacing, will be paid for at the contract unit bid price, which price and payment shall be full compensation for all labor, tools, equipment and incidentals necessary to complete the respective items in acceptable manner.

Item No.	Item Description	Unit
1611	Exist. Surf. Prep.—Subgrade	Mile
1612	Exist. Surf. Prep.—Agg. Surf.	Mile
1613	Exist. Surf. Prep.—Bit. Surf.	Mile
1614	Exist. Surf. Prep.—Subgrade	Sta.
1615	Exist. Surf. Prep.—Agg. Surf.	Sta.
1616	Exist. Surf. Prep.—Bit. Surf.	Sta.
1617	Exist. Surf. Prep.—Subgrade	Sq. Yd.
1618	Exist. Surf. Prep.—Agg. Surf.	Sq. Yd.
1619	Exist. Surf. Prep.—Bit. Surf.	Sq. Yd.
1621	Exist. Surf. Rem.—Subgrade	Mile
1622	Exist. Surf. Rem.—Agg. Surf.	Mile
1623	Exist. Surf. Rem.—Bit. Surf.	Mile
1624	Exist. Surf. Rem.—Subgrade	Sta.
1625	Exist. Surf. Rem.—Agg. Surf.	Sta.
1626	Exist. Surf. Rem.—Bit. Surf.	Sta.
1627	Exist. Surf. Rem.—Subgrade	Sq. Yd.
1628	Exist. Surf. Rem.—Agg. Surf.	Sq. Yd.
1629	Exist. Surf. Rem.—Bit. Surf.	Sq. Yd.

## SUBSECTION 16.30 TRAFFIC PROVISIONS

**16.31 DESCRIPTION.** "Traffic Provisions" describes and outlines methods to be employed by the Contractor in providing additional safety on projects, where public traffic is required to pass through construction, when work activity is of such kind and nature as to require features of traffic safety and control more positive and extensive than those afforded by standard requirements.

When "Traffic Provisions" is specified by the proposal the contractor shall, at all times work is in progress on each section of grading, gravel surfacing or bituminous construction, furnish and have on duty a flagman equipped in the manner described herein, at each end of any such section of work over which public traffic is compelled to travel. In the instance of bituminous seal coating or bituminous treatment work a pilot vehicle, with operator, will be required in addition to the flagmen. On these two types of bituminous construction the contractor also will be required to maintain flagmen and a pilot vehicle on the work for a period of twenty-four (24) hours following the placing of the freshly spread bituminous cover aggregate.

"Traffic Provisions" will be specified in the plans and/or proposal by schedule or schedules according to the type of traffic safety and control required of the work.

**Schedule 1.** Requires the furnishing of two flagmen and necessary signals, signs, lights and incidentals for each section of grading, gravel surfacing or bituminous construction at all times work is in progress on any of these sections of construction over which public traffic is compelled to travel.

**Schedule 2.** Requires the furnishing of two flagmen and necessary signals, signs, lights and incidentals and pilot vehicle with operator and signs while work is in progress and for a twenty-four (24) hour period on freshly spread cover material on any type of bituminous treatment or seal coat work.

On any construction project "traffic protection," when in effect, shall be accomplished in accordance with the methods hereinafter outlined in this specification.

**16.32 EQUIPMENT AND PERSONNEL. Signals, Signs, Lights, Incidentals.** (a) **Hand Signals:** elliptical shape 14"x11", constructed of plywood, masonite, aluminum, etc.; word "STOP," letter height 5", white on bright red field; opposite side, black letters "SLOW" on bright yellow field. Signal shall be mounted on suitable hand staff at right angles to long axis of ellipse.

(b) **Signs:** diamond shaped, 24"x24", constructed of 16 gauge steel or 0.091" aluminum; reflectorized both sides; both sides yellow background; with black letters "STOP FOR FLAGMAN;" reverse side, black letters "SLOW FOR FLAGMAN;" words, one to each line, in proper order, horizontal to diamond axis; letter height 5" except the word "FOR" which shall be 3". A shaft of wood or metal with 12"x12" red cloth flag attached shall be securely fastened to the sign or tripod in vertical position in such manner that the bottom of the flag will have 12" clearance above the sign peak.

(c) **Tripod:** Portable tripods for displaying the "flagman" sign, shall be in accordance with or equal to the design of Figure I, Montana Sign Manual (Maintenance).

(d) **Sign for Pilot Vehicle:** This sign shall be 36" long by 20" high, white background with black letters 6" high of proportionate width, "PILOT CAR" top line, "DO NOT PASS" lower line. Pilot car shall also be equipped with a 12"x12" brilliant red cloth flag mounted on left fender or cab.

(e) **Lights:** Flagmen on duty at night shall be stationed with a white light of sufficient brilliance to clearly outline their figures. Hand equipment for night will include a five cell red flashlight or lantern of equal brilliance. Flashing yellow or red signal lights or pot flares will be required at the "flagman" signs.

All signs and signals shall be of commercial manufacture or type and of standard kind. Letters shall be weighty in type and in proportion with letter height and sign dimension. Signs and signals with lettering shall be maintained in freshly painted and clean condition at all times.

(f) **Flagmen:** Only reliable persons, physically active and mentally alert, shall be assigned as flagmen. Flagmen shall present a neat, clean appearance and shall competently and courteously direct traffic and inform drivers of conditions and restrictions on the construction work. On occasion it may also become the duty of flagmen to hand out courtesy cards, furnished by the Highway Department, to traffic drivers.

It will be the contractor's responsibility to instruct and properly supervise flagmen in their duties.

Flagmen will station themselves near the edge of the oncoming traffic lane. They shall wear bright red headgear and a 6" width red cloth band around the upper left arm. In daylight they shall have in hand a signal of the specified kind and in place a "flagman" sign of the kind described. The sign with red flag attached shall be displayed on the hereinbefore specified tripod, facing traffic, at the edge of the oncoming traffic lane five-hundred (500) feet from the flagman. At night the sign shall be marked with a pot flare or yellow or red flashing signal. The flagman at night shall have at his side lighted, the illumination light of the kind described and in hand, instead of the daylight "STOP" or "SLOW" signal, he shall have a five cell red flashlight or lantern of equal brilliance, which he shall wave in suitable fashion at oncoming drivers, for the purpose of "slowing" or "stopping" vehicles as required.

The hand signal for daylight and the sign used shall be appropriate to the type of traffic control being exercised "STOP" or "SLOW" as the case may be. If vehicles are being brought to full stop, the flagman shall hold the hand signal in outstretched right hand in such position that the signal may be easily read by approaching drivers. Immediately upon the vehicle coming to a stop the flagman shall, courteously and briefly but accurately, advise each driver of the traffic regulations in effect on the control section and give instructions to proceed accordingly.

If "SLOW" control is in effect, the flagman shall hold out the "SLOW" signal and upon the vehicle slowing satisfactorily, the flagman shall lower the signal and beckon the driver on with his left hand.

(g) **Pilot Vehicle:** The contractor shall furnish a fully operable pilot car, pickup or other suitable vehicle together with operator. The vehicle shall have the "PILOT CAR" sign mounted on the vehicle at such height above the roadway surface that it can be plainly seen for a distance of five-hundred (500) feet from the rear. The pilot car shall lead one way traffic through the construction work and shall operate at a speed compatible with the character of the work and



safety of the traffic being conducted through the work. Upon reaching the end of a control section the pilot car shall stop on the extreme right side of the roadway and the operator shall wave traffic on with his left hand.

On certain types of work on relatively short control sections for one way traffic it will be permissible, under certain conditions, to handle traffic without the use of a pilot car. In these cases traffic will be held up on alternate ends of the section. The last car in the traffic line will carry a "baton" from one flagman to the other which shall be the signal to the flagman receiving the "baton" that the lane is clear for the line being held up to proceed. The flagman shall not permit traffic to start until he has assured himself that the lane is clear of all oncoming vehicles.

It is of top importance that flagmen, and others connected with the responsibility of traffic control, discharge the duties thereof with alertness and particular attention toward maintenance of utmost safety and protection for public traffic.

**16.33 METHOD OF MEASUREMENT.** When stipulated in the proposal, Schedule 1 of Traffic Provisions will be measured by the hour for "flagman hours."

When stipulated in the proposal, Schedule 2 of Traffic Provisions will be measured by the hour for each of the separate units "flagman hours" and "pilot vehicle hours."

When specified, but not stipulated in the proposal, traffic provisions will not be measured separately but shall be considered incidental and necessary to the performance of the other items of the contract.

**16.34 BASIS OF PAYMENT.** When stipulated in the proposal, schedule 1 or schedule 2 of traffic provisions as measured will be paid for at the unit price bid for each of the separate items specified and used in the completed and accepted work, which prices and payment for each shall be full compensation for all labor, tools, signs, signals, lights, equipment and incidentals necessary to satisfactory completion of the items.

When specified, but not stipulated in the proposal, traffic provisions will not be paid for directly but shall be considered incidental to and included in payment for the other items of the contract.

Item Number	Item Description	Unit
1631	Traffic Provisions—Schedule 1	Hour
1633	Traffic Provisions—Schedule 2—Flagman	Hour
1634	Traffic Provisions—Schedule 2—Pilot Vehicle	Hour



**SUBSECTION 16.40 OBLITERATION OF OLD ROADWAY**

**16.41 DESCRIPTION.** "Obliteration of old roadway" shall consist of the obliteration, in accordance with these specifications, of such portions of abandoned roadways as are shown on the plans, or designated by the engineer, for obliteration and shall include the appropriate grading, scarifying, plowing and harrowing of such areas of the old roadway as directed.

**16.42 CONSTRUCTION METHODS.** After the old road is no longer needed for traffic the old ditches shall be filled and the roadway graded, either to approximately restore the original contour of the ground or to produce a contour that will merge with the contour of the adjoining land. Where feasible, the old ditches may be filled by blading the existing surface material into them and covering it with suitable soil. Old structures, including guard rail, not included in other bid items for removing structures shall be broken down and buried or removed, as directed. All material with salvage value shall be carefully removed and neatly piled to avoid damage.

After the rough grading is completed the area of the old road surfacing shall be scarified or plowed to effectively mix the remaining metal with earth and the entire area of the old roadway shall be harrowed and smoothed. The entire area shall be left with a smooth surface, having rounded slopes level enough to permit cultivation.

**16.43 METHOD OF MEASUREMENT.** The length of old roadway obliterated to be paid for will be (a) the number of miles and fractions thereof determined to the nearest one-hundredth (0.01) or be (b) the number of stations (100 feet) of roadway, measured along the centerline, obliterated as required and accepted.

**16.44 BASIS OF PAYMENT.** When the proposal contains an estimate quantity for "Obliteration of Old Roadway," the number of miles, or stations, determined as provided above, will be paid for at the contract unit price bid for "Obliteration of Old Roadway," which price and payment will be full compensation for all material, labor, equipment, tools and incidentals necessary to complete this item, except as provided in (a) and (b) of this article.

(a) Material obtained from the old roadway and used in construction of the new roadway will be paid for under Section 11, "Borrow Excavation" and Section 12, "Overhaul," as the case may be.

(b) When the proposal does not contain an estimated quantity for "Obliteration of Old Roadway," this item will not be paid for directly but shall be considered incidental to and included in payment for the other items of the contract.

Item Number	Item Description	Unit
1641	Obliteration of Old Roadway	Mile
1642	Obliteration of Old Roadway	Station



**SECTION 17**

**EROSION CONTROL**



## SUBSECTION 17.00 TOPSOIL

**17.01 DESCRIPTION.** "Topsoil" shall consist of furnishing, excavating, hauling, depositing, spreading and preparing for seeding an approved material in accordance with these specifications. Generally, topsoil will be placed on median areas, outer separation areas and side slopes of roadway sections in conformance with the lines, grades and dimensions shown on the plans and/or as directed by the engineer. Topsoil may be stockpiled for use on a future contract under certain circumstances.

**17.02 MATERIAL.** Topsoil material shall consist of a fertile, friable soil of loamy character, typical of the topsoil in the locality, and shall contain a normal amount of organic matter. It shall be reasonably free of roots, hard dirt, clay, rocks, weeds and other materials which will prevent the formation of a suitable seed bed.

Unless otherwise stipulated, topsoil shall be obtained from sources within the bounds of the highway and shall be removed only from the areas and locations designated on the plans or directed by the engineer.

When stipulated in the contract, topsoil shall be obtained from outside the bounds of the highway. Unless otherwise provided, the contractor shall make his own arrangements for obtaining such topsoil and he shall pay all costs involved with royalties and any other charges, developing the source and smoothing and levelling the source after removal.

**17.03 CONSTRUCTION METHODS.** The subgrade within the areas to be covered with topsoil shall be completed to the lines, grades and elevations shown on the plans or designated by the engineer. The subgrade surfaces shall first be shaped, trimmed and smoothed by means of a blade grader, drag or other approved equipment. Topsoil shall not be placed until the areas to be covered have been properly prepared and all construction work in the area has been completed. Topsoil shall be placed and spread so that it will have a minimum compacted thickness of four (4) inches when finished to the lines, grades and locations shown on the plans or designated by the engineer. After the spreading of the topsoil, all large stiff clods, hard lumps, large stones, brush, roots (other than native grass roots), stumps, litter or other foreign material shall be raked up and removed from the topsoil area and the topsoil shall be keyed into the underlying soil by four complete discings with a weighted disc harrow set straight. If the topsoil is not satisfactorily pulverized beneath the surface, in the opinion of the engineer, working of the soil shall be continued with a disc harrow, tooth harrow or a corrugated roller until the desired condition is obtained. Spreading shall be completed in such a manner that seeding, or planting, can proceed after completion of this item without additional soil preparation of any nature.

Acceptable topsoil material encountered in roadway excavation work may be deposited (a) in uniform windrows along the tops of excavation slopes in the amounts ordered by

the engineer and in such a manner that it can be uniformly spread over the slopes or (b) in convenient stockpiles for spreading in areas designated on the plans or as directed by the engineer or for use in a future contract.

**17.04 METHOD OF MEASUREMENT.** Topsoil will be measured by the cubic yard in the hauling vehicle at the point of delivery at the area where it is to be placed or at the stockpile site. In order to aid checking of loads, the contractor shall strike off or level any load when ordered by the engineer.

When necessary to remove any material such as rock, hard dirt, clay, weeds, roots, or any other deleterious matter from the topsoil after placing, the amount of such material will be measured by the cubic yard, returned to the topsoil source and it will be deducted from the total amount of topsoil placed.

**17.05 BASIS OF PAYMENT.** Topsoil used in the completed and accepted work will be paid for at the contract unit bid price, which price and payment will include furnishing royalties, unless otherwise stipulated, loading, hauling, placing, pulverizing, spreading, shaping, watering, smoothing, rolling, finishing and for all other charges; for maintenance of the completed surface until acceptance and for all manipulations, labor, tools, equipment and all incidentals necessary to complete the work.

Item Number	Item Description	Unit
1701	Topsoil	Cubic Yard
1702	Topsoil—stockpiled	Cubic Yard

## SUBSECTION 17.10 SEEDING

**17.11 DESCRIPTION.** "Seeding" shall consist of ground surface preparation, tillage, furnishing and planting seed of designated species and/or variety on shoulders, slopes, borrow areas and other areas shown on the plans and/or designated by the engineer, including clean-up and smoothing to grade, in accordance with these specifications.

**17.12 MATERIALS.** (1) All seed shall be of a good standard grade and shall comply with applicable State and Federal seed laws. All kinds of seeds, even when specified for mixing, shall be furnished and delivered separately packaged or bagged. Before any seed is planted, the engineer shall be furnished a certified purity analysis and germination test of the seed proposed for use. The kind, quantity, minimum percentage of purity and germination and maximum allowable weed seed content of seed will be shown on the plans and/or stipulated in the proposal. Seed which has become wet, moldy, or otherwise damaged in transit or storage will not be acceptable.

(2) The kind and quantity of fertilizer, if specified, will be shown on the plans and/or stipulated in the proposal.



**17.13 CONSTRUCTION METHODS.** (1) **General.** All areas to be seeded shall be completed to the stipulated lines and grades and finished uniformly and smoothly before beginning seeding operations. Seeding shall not be undertaken when wind velocity is great enough to waste or unevenly distribute the seed, or when the soil is frozen, excessively wet, excessively dry, or otherwise in a non-tillable condition.

(2) **Seedbed Preparation.** The top two inches of soil, unless already finely divided and permeable, shall be disced or otherwise broken up and pulverized until in a clod-free condition. After breaking and pulverizing, the soil shall be compacted, before seeding, with a rolling-type culti-packer until the seedbed is firm.

Finely divided, permeable, loose soils shall be compacted with an approved rolling-type culti-packer, before seeding, until the seedbed is firm. Any objectionable growth of weeds shall be removed by light tillage before the soil is compacted.

If fertilizer is specified, it shall be distributed evenly and uniformly in the specified quantity. It shall be incorporated into the soil during or immediately after application, and shall be placed deep enough to protect it from the erosive action of wind and water.

(3) **Seeding Operations.** Seeds shall be planted by means of a machine or hand operated planting drill set to plant the seeds to a depth as recommended for the type of seed being planted and not to exceed seven (7) inches between rows. Where directed by the engineer, on steep fill or back slopes that are inaccessible to heavy machines, the seeding shall be accomplished by a hand operated drill or by hand sowing and raking with a hand rake.

On all slopes of 2:1 or steeper, seeding shall be performed by hand methods or by use of power sprayers, blowers or other approved equipment.

**17.14 METHOD OF MEASUREMENT.** (1) Seeding will be measured by the actual number of acres, calculated to the nearest tenth, or by the square yard. Measurements will be made on the plane of the seeded surface.

(2) Fertilizer will be measured by the ton of two-thousand (2,000) pounds applied to the surface.

**17.15 BASIS OF PAYMENT.** (1) Seeding will be paid for at the contract unit bid price, which price and payment shall be full compensation for furnishing all seed, hauling, seedbed preparation, drilling, planting, spreading, watering and for all material, labor, tools, equipment and incidentals necessary to complete the item.

(2) Fertilizer, if specified, will be paid for at the contract unit bid price, which price and payment shall be full compensation for furnishing, hauling, applying, mixing and for all labor, tools, equipment and incidentals necessary to complete the item.



Item Number	Item Description	Unit
1711	Seeding	Acre
1712	Seeding	Sq. Yard
1715	Fertilizer	Ton

### SUBSECTION 17.20 MULCHING

**17.21 DESCRIPTION.** "Mulching" shall consist of covering and processing specified areas with a mulch of the required material.

**17.22 MATERIALS.** Mulching material shall consist of hay, grain, straw, cuttings of agricultural grasses or legumes, peat, or well rotted stable manure containing at least fifty (50) percent of hay or straw bedding. All mulch material shall be relatively free from seed-bearing stalks of noxious grasses or weeds. Mixtures of mulch materials shall be free from stones, stiff clay, hard dirt, roots, stumps or other fallen material.

**17.23 CONSTRUCTION METHODS.** Immediately after the area designated to be mulched has been seeded the mulch material shall be uniformly spread to a depth of two (2) inches loose measurement. The material shall be disced into the soil so that it is partially covered. The discing operation shall be performed parallel to the roadway with a disc or mulching tiller. Care shall be exercised to obtain a reasonably even distribution of straw partly incorporated into the soil. If the size of the area to be mulched is too small or the area is of such a nature that it is impractical to use a disc, a light covering of top soil may be spread over the mulch material for anchorage.

The contractor shall arrange his work so that the mulch can be placed and disced immediately after each area is seeded. No mulching work shall be carried on during periods when high winds will drift or blow the mulch material.

Prior to final acceptance of the project the contractor, at his own expense, shall immediately remulch any area from which the original mulch may have been washed or blown off. If the original seed bed and seeding is damaged due to the displacement of the mulching material the seedbed shall be repaired and reseeded before remulching.

**17.24 METHOD OF MEASUREMENT.** Mulching will be measured by the actual number of acres, calculated to the nearest tenth, or by the square yard. Measurements will be made on the plane of the mulched surface.

**17.25 BASIS OF PAYMENT.** Mulching will be paid for at the contract unit bid price, which price and payment shall be full compensation for furnishing all material, hauling, placing, and spreading the materials, and for all labor, tools, equipment and incidentals necessary to complete the item.

Item Number	Item Description	Unit
1721	Mulching	Acre
1722	Mulching	Square Yard





## **SECTION 20**

### **AGGREGATE SURFACING GENERAL CONDITIONS**



**20.01 DESCRIPTION.** This specification determines the general requirements of the various types of aggregate materials used as surfacing, kinds of equipment, production methods, construction methods, surface smoothness, and other provisions concerning all aggregate surfacing.

The specific type and grading of aggregate surfacing will be indicated on the plans and/or in the proposal, which types and gradings are described in subsequent sections of these specifications.

**20.02 MATERIAL.** (a) Aggregate surfacing materials shall be obtained from acceptable sources which may be indicated on the plans or described in the proposal and/or from authorized supplementary acceptable sources selected under the direction of the engineer.

All aggregate surfacing materials shall be free from vegetable matter, balls of clay, frozen lumps or other extraneous matter and shall conform to the specifications as detailed in subsequent sections for the particular type and grading stipulated in the proposal and/or shown on the plans.

The contractor shall use reasonable care in the selection of material in a pit so that a uniform product will be produced at all times. Unless otherwise specified, no compensation will be allowed for such stripping of the pit as may be required in order that satisfactory aggregate material may be secured.

(b) Binder or filler. All the requirements of Section 26, "Binder or Filler," shall be complied with when such material, in addition to that naturally present in any type of aggregate surfacing material, is required for satisfactory bonding and/or gradation prerequisites.

(c) Sources of surfacing materials shall be furnished by the contractor, unless otherwise specified. Should the contractor elect to produce these surfacing materials from Commission controlled source or sources, he may do so at no cost or royalty.

The source or sources of surfacing, when shown, are for the purpose of indicating where tests have indicated acceptable material may be obtained, but the contractor is not restricted to any source if materials with tests acceptable to the engineer can be obtained from other deposits. When source or sources are shown, it is with the understanding that the Commission does not guarantee the quality or quantity of the material.

**20.03 EQUIPMENT.** (a) **Crushing Equipment.** Crushers shall have capacity to break rock fragments or boulders passing a screen with ten (10) inch square openings.

Crushing plant screening equipment shall be fitted, when required, with blowers or other devices capable of removing excess and/or undesirable fines.

(b) **Screening Plants.** Screening plants shall consist of a revolving trommel screen, shaker screen, vibrating screen, or other devices capable of removing oversize material, excess and/or undesirable fines.

(c) **Motor Graders.** Motor graders may be either self-propelled motor graders, weighing not less than twenty-thousand (20,000) pounds and/or pull-type graders with a wheel base not less than eighteen (18) feet. All graders shall be rubber-tired, equipped with moldboards not less than twelve (12) feet in length and shall have tractive power adequate to the efficiency of their assigned operation. If track-type tractors are used, the tracks shall be equipped with either rubber or smooth metal plate treads and these tractors shall not be permitted to turn on the newly completed work at any time. Units equipped with scarifiers shall have the scarifiers so constructed as to provide positive adjustment of the scarifier depth.

(d) **Rollers.** Rollers shall meet requirements for the particular class of work designated in Section 14, "Rolling."

(e) **Scales.** Scales, when required, shall be furnished by and at the expense of the contractor. They shall be satisfactory to the engineer and shall be tested and sealed at the expense of the contractor prior to their use on the project and as often thereafter as the engineer may consider necessary to insure their accuracy.

The contractor shall furnish and have on hand at all times at his own expense, not less than ten (10) certified fifty (50) pound weights for checking the scales.

When measured by the ton, the material shall be weighed on scales of a type capable of weighing complete loads in an unbroken operation.

The recording devices of the scales shall be housed in a suitable manner and the scales shall be so located as to facilitate accurate weighing of loads. The scales shall be accurate to one-half ( $\frac{1}{2}$ ) of one (1.0) per cent at any weight.

(f) **Field Laboratory.** Unless otherwise specified in the proposal, the contractor shall provide and maintain, at the site of the work and at a location designated by the engineer, a building for exclusive use as a field laboratory by the engineer. This building shall be not less than eight (8) feet in width and fourteen (14) feet in length and eight (8) feet in height, and shall be well constructed and weatherproof.

It shall be constructed so that it may be moved from one point to another on the project and shall be fitted with a door and windows and equipped with a work bench and chairs, a two-burner bottled-gas plate complete with tank and fuel for drying materials, a stove and fuel for heating, when required, and an adequate easily accessible supply of water to be used for the testing of materials. Use of a trailer house, not less than seven (7) feet wide and fourteen (14) feet long, will also be permitted, provided it conforms in other respects with the requirements herein set forth.



Unless otherwise provided the laboratory, after completion of the project, shall remain the property of the contractor.

Payment for the laboratory, complete with furnishings, fuel, maintenance and moving on the project as directed, unless otherwise stipulated, will be considered incidental and necessary to the performance of and included in payment for the surfacing items of the contract.

**20.04 PRODUCTION METHODS.** Except as may be otherwise specified, the intention of these specifications is to provide for crushed gravel, crushed rock surfacing, cover material or stone chips containing as large a proportion as possible of crushed aggregate. The entire volume of oversize material in the source shall be passed through the various crushing or reduction units until such oversize has been reduced to the sizes specified. Oversize material retained on a screen having 10-inch square openings may be rejected. The crushed material should be combined with the screened material in such a manner that a composite product will be obtained.

No surfacing material will be accepted which is loaded into hauling units in a segregated condition or which does not conform to the required grading.

In case the material deposit contains sand or other material, in excess of the specification gradation requirements, or of an unacceptable quality, such excess or undesirable material shall be removed and disposed of prior to crushing, or during screening operations if crushing is not required.

When production is from sources made available by the State, material rejected in the manufacture of surfacing aggregate shall be disposed of as directed and will remain the property of the State.

**20.05 CONSTRUCTION METHODS.** (a) **Surface Preparation.** When the surfacing material is to be placed on a roadbed previously completed under a separate contract, the existing roadway surface shall be prepared in accordance with the requirements of Section 16.10, "Existing Surface Preparation," immediately prior to placing any new surfacing under the current contract. In the case of surfacing material being included in a contract involving grading and aggregate surfacing construction, existing surface preparation shall be performed and in conformance with the provisions of that contract.

(b) **Placing.** No surfacing material shall be placed upon a frozen, wet, muddy, or rutted surface, subgrade or gravel, unless otherwise directed. At least one mile of finished and accepted earth graded roadway or completely finished surfacing course shall be kept in advance of the placing of any initial or subsequent surfacing course.

Depositing and/or spreading of the material on the prepared subgrade or existing surface or on a completed surfacing course shall commence at a point on the roadway farthest from the loading source, unless otherwise directed, and shall progress continuously without breaks. The material

shall be deposited upon the subgrade or preceding course of material in such uniform manner, approved by the engineer, as to insure the ultimate planned thickness of the course being placed, following its final spreading and compaction.

The material in any surfacing course shall be mixed and placed in horizontal layers of not more than four (4) inches compacted thickness. The material shall be deposited and spread in a uniform layer, with no segregation of size, to such loose depth that when compacted, making due allowances for any filler that is to be blended on the road, the layer shall have the required thickness.

After the material is deposited and/or spread upon the roadway it shall be thoroughly mixed with a blade grader, of the type specified, to the full depth of the layer, by blading all the material for the layer entirely across the roadway into a windrow before its final spreading is begun.

Traveling mixers or plants which will also prevent segregation of the material and provide for its uniform gradation, may be used in lieu of blade mixing, if approved by the engineer. When directed, the material shall be watered during the process of mixing.

Each layer of material, after mixing to uniform gradation, shall be spread smooth without segregation of size to conformance with the typical section shown on the plans and thoroughly compacted by rolling, supplemented by watering, if directed, before the succeeding layer is placed.

**(c) Binder or Filler.** The operation of blending binder or filler shall be performed in accordance with the requirements of Section 26, "Binder or Filler."

**(d) Watering.** Prior to and during the mixing operations, if directed by the engineer, water shall be added to the material in such quantities that the entire mass, during mixing, is wetted to such an extent as to prevent segregation of fine and coarse materials. Any watering shall be performed in accordance with the requirements of Section 15, "Watering."

**(e) Compaction.** (1) Unless otherwise specified, the subgrade and all surfacing materials shall be compacted in accordance with the pertinent class of work requirements of Section 14, "Rolling." When directed, watering shall be performed prior to and during rolling operations.

(2) **Traffic Compaction.** If there are no units of Item No. 1403, "Rolling Aggregate Surface Courses," stipulated in the proposal, the surfacing shall be compacted by traffic. In such case, the depositing and spreading of material on the roadway shall start at the point nearest the point of loading.

Blading and/or dragging, supplemented with watering when directed, shall accompany traffic compaction. The surface shall be kept free of irregularities until acceptance of the work.

Where the traffic method of compaction is used the material shall be processed and spread as closely behind the dumping units as is practicable, but in no case shall the length of the unprocessed section exceed one-half ( $\frac{1}{2}$ ) mile.

**(f) Restrictions.** In addition to the restrictions imposed by State and Federal Laws on the speed, size and weight of vehicles, weight of loads and tire equipment, used in connection with the prosecution of work, the engineer may further restrict the speed of the hauling units and the weight of loads as he may find necessary to prevent damage to the previously constructed subgrade, base, surface course or courses, or public thoroughfares used in the prosecution of the work.

**20.06 SURFACE SMOOTHNESS.** The surface of any aggregate surfacing material course, when finished, shall be such that when tested with a ten (10) foot straightedge placed on the surface parallel to the centerline of the roadway, the minimum deviation of the surface from the plane of the straightedge shall nowhere exceed one-half ( $\frac{1}{2}$ ) of an inch. Should patching of any course be necessary, in order to meet such tolerances, it shall be performed by using methods approved by the engineer and using material the same as in the course being repaired. Payment for such material used for patching shall be at the unit price bid for the specified material, which payment shall be full compensation for all labor, tools, equipment and incidentals necessary to complete the work in an acceptable manner.

**20.07 METHODS OF MEASUREMENT.** (a) Any aggregate material used as surfacing will be measured by the cubic yard or by the ton of two thousand (2,000) pounds for the type or types of material stipulated in the proposal.

When measured by the cubic yard, measurement will be made of the loose material in the vehicle at point of delivery on the road. In order to aid checking of loads, the contractor shall strike or level any load, when ordered by the engineer.

When measured by the ton, the material shall be weighed on scales of the type prescribed in Article 20.02.

When necessary to remove oversize material from the roadway, resulting from the placing of surfacing material, the amount of such oversize material will be measured by the cubic yard or by the ton, as the case may be, returned to the aggregate source and it will be deducted from the total amount of surfacing material placed on the roadway.

(b) Rolling, watering, hauling and/or other contract items will be measured in accordance with the provisions of the respective sections or subsections.

(c) "Existing Surface Preparation," when specified, will be measured by the unit or units and/or other items required of the work, as stipulated in the proposal in accordance with the methods prescribed in the pertinent sections for the respective items. When not stipulated, existing surface preparation will be considered incidental and necessary to the performance of the other items of the contract.

**20.08 BASIS OF PAYMENT.** (a) Aggregate material used as surfacing incorporated into accepted work will be paid for at the contract unit bid price, which price and payment, unless otherwise specified, will include furnishing all materials, production, handling, hauling, mixing, placing and spreading all materials and for all other charges; for maintenance of the completed surface until acceptance and for all manipulations, labor, tools, equipment and all incidentals necessary to complete the work.

(b) Rolling, watering, hauling and/or other items will be paid for at the contract unit bid prices in accordance with the requirements of the respective sections or subsections.

(c) "Existing Surface Preparation" will be paid for at the contract unit, or units, bid price or prices or other items required of the work which prices and payment will include all labor, tools, equipment and incidentals necessary to complete the work. Unless otherwise provided, existing surface preparation will not be paid for directly but will be considered incidental and necessary to the performance of payment for the other items of the contract.

Item numbers for various types of aggregate surfacing will be found at the end of each pertinent section or subsection.







## SECTION 21

### VARIOUS SURFACING TYPES



**SUBSECTION 21.00 SELECTED SURFACING**

**21.01 DESCRIPTION.** "Selected Surfacing" shall consist of one or more courses of aggregate surfacing composed of the grading of material stipulated in the proposal and/or shown on the plans, constructed on the roadway in conformity with these requirements and the specifications and plans.

**21.02 MATERIALS.** (a) Selected surfacing material shall conform to the requirements of Paragraph (a) of Article 20.02, "Material," of Section 20, "Aggregate Surfacing—General Conditions," and to the particular grading stipulated in the proposal and/or shown on the plans.

As determined by A.A.S.H.O. Methods T-11 and T-27, "Selected Surfacing" shall, for the grading specified, meet the requirements of that grading in the table of gradations.

**TABLE OF GRADATIONS****PERCENTAGES BY WEIGHT PASSING SQUARE MESH SIEVES—T-27**

Passing	Grading 1	Grading 2	Grading 3	Grading 4	Grading 5	Grading 6
4 Inch .....	100%					
3 Inch .....		100%				
2½ Inch .....			100%			
2 Inch .....				100%		
1½ Inch .....					100%	
1 Inch .....						100%
No. 200 Sieve						
Less Than .....	20%	20%	20%	20%	20%	20%

The material passing the No. 40 sieve shall not have a liquid limit in excess of twenty-five (25), nor a plasticity index in excess of six (6), as determined by A.A.S.H.O. Methods T-89, T-90 and T-91, provided however, that material having a zero (0) or non-plastic index may have a liquid limit of not to exceed thirty (30).

"Selected Surfacing" shall conform to any other requirements that may be stipulated in the proposal, which requirements may modify or amend these specifications, and which may be developed upon specific job conditions and/or source of material.

(b) Binder or filler, if required and/or stipulated, shall conform to the requirements of Paragraph (b) of Article 20.02, "Material," of Section 20.

**21.03 to 21.08 (Inclusive) EQUIPMENT, PRODUCTION METHODS, CONSTRUCTION METHODS, SURFACE SMOOTHNESS, METHODS OF MEASUREMENT AND BASIS OF PAYMENT** shall apply to the methods of production, placing, measurement and payment of selected surfacing and conforming to the provisions, respectively, of Articles 20.02 to 20.08 (inclusive) of Section 20.

Item	Description	Unit	Item No.	Item No.	Unit
Selected Surfacing—Grade 1	Cubic Yd.	2101	Ton	2111	
Selected Surfacing—Grade 2	Cubic Yd.	2102	Ton	2112	
Selected Surfacing—Grade 3	Cubic Yd.	2103	Ton	2113	
Selected Surfacing—Grade 4	Cubic Yd.	2104	Ton	2114	
Selected Surfacing—Grade 5	Cubic Yd.	2105	Ton	2115	
Selected Surfacing—Grade 6	Cubic Yd.	2106	Ton	2116	

### SUBSECTION 21.50 SAND SURFACING

**21.51 DESCRIPTION.** "Sand Surfacing" shall consist of one or more courses of sand composed of material stipulated in the proposal and/or shown on the plans, constructed on the roadway in conformity with these requirements and the specifications and plans. In general, the sand material will be placed in one course on a newly-constructed subgrade to serve as a choke, stabilizing, cushion or foundation course for subsequent surfacing of other types.

**21.52 MATERIAL.** (a) "Sand Surfacing" shall conform to the requirements of Paragraph (a) of Article 20.02, "Material," of Section 20 "Aggregate Surfacing—General Conditions" and to the particular specifications for the type and grading stipulated in the proposal and/or shown on the plans.

As determined by A.A.S.H.O. Methods T-11 and T-27, "Sand Surfacing" shall, for the grading specified, meet the requirements of that grading in the table of gradations.

### TABLE OF GRADATIONS

#### PERCENTAGES BY WEIGHT PASSING, SQUARE MESH SIEVES—T-27

Passing	Grading 1	Grading 2	Grading 3	Grading 4	Grading 5	Grading 6
1½ Inch .....	100%					
1 Inch .....		100%				100%
¾ Inch .....			100%			
½ Inch .....				100%		
No. 4 Sieve .....					100%	
No. 10 Sieve .....						
Not Less Than .....	65%	65%	65%	50%	50%	50%
No. 200 Sieve .....						
Not More Than .....	20%	20%	20%	20%	20%	10%

The material passing the No. 40 sieve shall not have a liquid limit in excess of twenty-five (25), nor a plasticity index in excess of zero (0), as determined by A.A.S.H.O. Methods T-89, T-90 and T-91.

"Sand Surfacing" shall conform to any other requirements that may be stipulated in the proposal, which requirements may modify or amend these specifications and which may be developed upon specific job conditions and/or source of material.

(b) Binder or filler, if required and/or stipulated, shall conform to the requirements of Paragraph (b) of Article 20.02, "Material" of Section 20.

**21.53 CONSTRUCTION METHODS. (Supplemental).** The sand material shall be deposited upon the roadway and spread with blade graders or other approved equipment in such manner as to insure the ultimate planned thickness of the layer being placed following its final spreading and compaction. The material in any sand course shall be placed in horizontal layers of not more than six (6) inches compacted thickness when directed. The sand shall be watered during and/or after spreading and compacted by rolling.

Immediately after placing, the sand material shall be covered with the specified surfacing in conformance with the plans and specifications. The sand material shall not be placed further than one-thousand (1,000) feet in advance of the succeeding course of surfacing.

**21.54 to 21.58 (Inclusive) EQUIPMENT, PRODUCTION METHODS, CONSTRUCTION METHODS, METHODS OF MEASUREMENT AND BASIS OF PAYMENT** shall apply to the methods of production, placing (except as herein supplemented), measurement and payment of sand surfacing and conforming to the requirements respectively of Articles 20.03, 20.04, 20.05, 20.07 and 20.08 of Section 20.

Item Description	Unit	Item No.	Unit	Item No.
Sand Surfacing—Grade 1	Cubic Yard	2151	Ton	2161
Sand Surfacing—Grade 2	Cubic Yard	2152	Ton	2162
Sand Surfacing—Grade 3	Cubic Yard	2153	Ton	2163
Sand Surfacing—Grade 4	Cubic Yard	2154	Ton	2164
Sand Surfacing—Grade 5	Cubic Yard	2155	Ton	2165
Sand Surfacing—Grade 6	Cubic Yard	2156	Ton	2166



**SECTION 22**

**SURFACE STABILIZATION**





**SUBSECTION 22.10 AGGREGATE ADMIXTURE**

**22.11 DESCRIPTION.** "Aggregate Admixture" shall compose a stabilized aggregate surface constructed in a roadway operation by admixing the specified surfacing aggregate with binder or filler obtained from the subgrade surface in conformity with these requirements and the specifications and plans.

**22.12 MATERIAL.** (a) Aggregate surfacing to be used in the admixture shall conform to the requirements of Paragraph (a), Article 20.02, "Material," of Section 20, "Aggregate Surfacing—General Conditions," and to the particular specifications for the type and grading stipulated in the proposal and/or shown on the plans.

**22.13 CONSTRUCTION METHODS. (Supplemental)** Following preparation as specified, the entire subgrade surface shall be scarified or loosened to a uniform depth as shown on the plans and/or as directed. The operation of scarifying shall not be completed further in advance than can be covered by one (1) day's run of placing the specified aggregate. All oversize material, either loose or partly buried, that is larger than the maximum grading of the specified aggregate, shall be removed from the subgrade, surface and disposed of as directed.

Immediately after the surface has been scarified and all clods and lumps broken down to such size that all material will pass a three-fourth ( $\frac{3}{4}$ ) inch square opening, the scarified material shall be bladed into a uniform windrow on one (1) side of the roadway. The window shall be equalized throughout its entire length and shall be of the total loose volume required for blending with the specified aggregate.

After the specified aggregate has been deposited upon the roadway and uniformly windrowed, the operation of processing and combining the aggregate and the windrowed blending material shall commence. The two materials shall be moved from side to side of the roadway with the specified type of blade graders and/or with blending machines of acceptable type until both materials are thoroughly mixed and combined. Such manipulations shall be carried on until the entire mass of aggregate and blending material, supplemented by watering when directed, is completely mixed.

The admixed material shall then be spread smooth, without segregation of grading, to conformance with the plans and thoroughly compacted. If there are no units of Item No. 1403, "Rolling Aggregate Surface Courses," stipulated in the proposal the surface shall be compacted in accordance with the requirements of Paragraph (2) (e) "Traffic Compaction," Article 20.05, "Construction Methods," of Section 20.

**22.14 to 22.19 (Inclusive) EQUIPMENT, PRODUCTION METHODS, CONSTRUCTION METHODS, SURFACE SMOOTHNESS, METHODS OF MEASUREMENT AND BASIS OF PAYMENT** shall apply to the methods of production, placing, measurement and payment of aggregate admixture and conforming to the requirements respectively of Articles 20.03 to 20.08, (inclusive) of Section 20, except as herein supplemented and modified.

**22.20 METHOD OF MEASUREMENT AND BASIS OF PAYMENT. (modification)** Unless otherwise stipulated, aggregate admixture will not be measured or paid for directly, but will be considered incidental to and included in payment for the aggregate used in the admixture and shall include all scarifying and blending of the materials and all work required of the completed and accepted admixture surface.

If aggregate admixture is a bid item, it will be identified as follows.

Item Number	Item Description	Unit
2211	Aggregate Admixture	Cubic Yard
2216	Aggregate Admixture	Ton

### SUBSECTION 22.30 SOIL CEMENT STABILIZATION

**22.31 DESCRIPTION.** "Soil Cement Stabilization" shall consist of one or more courses of base surfacing composed of a combination of selected soils aggregate and Portland cement, uniformly mixed, moistened and compacted in accordance with these specifications and conforming to the lines, grades, thicknesses and typical cross section shown on the plans or as may be directed by the engineer.

**22.32 MATERIALS. (1) Portland Cement.** Portland Cement shall conform to the requirements of A.A.S.H.O. Specification M-85, Type I. One sack containing one (1) cubic foot of Portland Cement shall be considered as weighing ninety-four (94) pounds net. One barrel of cement shall be considered as weighing three-hundred-seventy-six (376) pounds net and containing four (4) cubic feet. The contractor, at his option, may use bulk cement, provided the equipment for handling, weighing and spreading is approved by the engineer.

**(2) Water.** Water used in the construction of this base course shall be from a source approved by the engineer and shall conform to the provisions of Paragraph (b), Article 46.04, Subsection 46.00.

**(3) Soil Aggregate.** The soil aggregate shall be obtained from approved sources. It is the intent of this specification to use the material from the approved sources subject to the following stipulations:

(a) Extreme care shall be used in removing the soil aggregate so that it is not contaminated with deleterious overburden or material from a lower or adjacent strata, and a uniform product is placed on the roadway.

(b) The maximum size, the grading and the quality of the soil aggregate shall conform to the requirements set forth in the special provisions.

(4) **Curing Seal, Bituminous Material.** The curing seal shall be the grade of bituminous material specified in the proposal form and conforming to the requirements of Section 30, "Bituminous Materials." It shall also serve as a tack coat for the wearing surface.

(5) **Cover Material.** The cover material to be spread over the curing seal, if any is to be used, shall be as specified by the proposal form.

**22.33 COMPOSITION AND PROPORTIONING. (1) Cement.** Portland Cement shall be applied at the rate determined by the engineer for the particular aggregate to be used. The approximate quantity, only, is shown on the plans. No processing of the base shall be started until all tests of the base material to be used have been completed and the exact quantity of the cement required for the particular aggregate has been determined.

(2) **Water.** The quantity of water required shall be the amount necessary for optimum moisture content in the compacted mixture. The quantity will vary with the nature of the aggregate and will be determined by the engineer.

**22.34 CONSTRUCTION METHODS. (1) Preparation.** Upon the previously prepared subgrade, sufficient soil aggregate shall be deposited and spread to form a base of the required compacted depth shown on the plans for the full width of the cement stabilized base course and shaped to the specified section and grade.

Any machine, combination of machines, equipment, or an approved central mixing plant may be used to produce the completed soil-cement base course meeting the requirements for soil pulverization, cement distribution, water application, incorporation of materials, compaction, finishing, and for providing protection and cover, as controlled by these specifications.

The machines and equipment used shall be in suitable operating condition and shall be approved by the engineer, prior to use.

(2) **Pulverizing.** The soil to be processed shall be scarified and pulverized prior to the application of cement. Pulverizing shall continue during mixing operations until a minimum of eighty (80) percent of the soil passes a No. 4 sieve, exclusive of any gravel or stone retained on a No. 4 sieve.

The scarifying shall be carefully controlled to the required depth. Unless special permission is given by the engineer, in writing, the length of roadway scarified and pulverized at any time shall not exceed the length which can be completed, in accordance with these specifications, in two (2) working days.

(3) **Application of Cement.** The required quantity of Portland Cement shall be spread uniformly in an approved manner. Spreading of Portland Cement shall be subject to the following restrictions:

(a) Only such cement shall be applied as can be completely processed, exclusive of final surface finishing, within six (6) hours after the addition of cement.

(b) No cement shall be applied when the moisture content of the loose soil exceeds by more than two (2) percent the specified optimum for the soil-cement mixture or when the moisture content of the soil will not permit a uniform and intimate mixture with the cement.

(c) No cement shall be applied until the subgrade is capable of withstanding, without displacement, the compaction specified for the soil-cement mixture.

(d) No equipment, except that used in spreading and mixing, will be allowed to pass over the freshly spread cement. Any equipment travelling over the spread cement shall be maintained at slow speed and any cement displaced shall be replaced before mixing is started.

(e) No cement shall be applied during periods of high winds which may occasion the loss of cement unless the contractor provides equipment capable of drilling the cement into the soil without loss.

**(4) Mixing.** Immediately after the cement has been distributed it shall be mixed with the loose soil for the full depth of treatment. Care must be exercised that no cement is mixed below the desired depth. Mixing shall be continued until a uniform and intimate mix of soil and cement is obtained.

Any mixture of soil and cement that has not been compacted and finished shall not remain undisturbed for more than thirty (30) minutes.

**(5) Application of Water.** Water supply and equipment shall be provided which will permit the continuous application of water on the section being processed. A portion of the water may be incorporated in the soil aggregate base course prior to addition of the cement.

Immediately after mixing of the soil aggregate and cement is complete, the moisture content of the soil-cement mixture shall be determined by the engineer and, if required, water shall be applied uniformly in such quantities and at such a rate as he may direct. Each application of water shall be partially incorporated by the equipment, specified hereinbefore, so as to avoid concentration of water near the surface. After the last application of water, mixing shall be continued by using sufficient equipment to distribute the water uniformly throughout the full depth of the mixture in one operation. Particular care shall be exercised to insure satisfactory moisture distribution along the edges of the section. A final moisture density test will be made on samples of moistened soil-cement from the roadway to determine final moisture and density requirements. When this mixing operation is completed, the amount of moisture in the mixture shall not vary from the specified optimum amount by more than ten (10) percent.



(6) **Moisture-Density Tests.** The moisture and density relationship shall be determined by A.A.S.H.O. Standard Method of Test for moisture-density relations of soil-cement mixtures, Designation T-134. The density to be obtained in the base under the specifications shall be not less than ninety-six (96) percent of the laboratory maximum dry weight per cubic foot.

(7) **Compaction and Finishing.** Immediately prior to the beginning of compaction the mixture shall be thoroughly loosened for its full depth. The loose mixture shall then be uniformly and continuously compacted until the entire width and depth of the cement treated base, in the lane being processed, is compacted to not less than ninety-six (96) percent of the laboratory maximum dry weight per cubic foot.

The choice of equipment for compaction is left to the contractor.

If the compaction is less than that specified, two (2) additional determinations will be made in the section and the results averaged. Should the average of the three (3) determinations fail to meet the specification requirements the section shall be reconstructed, at the contractor's expense, within twenty-four (24) hours.

After the mixture is compacted, the surface of the base shall be reshaped to the required lines, grades, and cross sections and then shall be lightly scarified by means of a harrow, nail-drag or other approved equipment until a uniform even surface mulch of approximately one (1) inch is obtained. The scarifying shall, at all times, be deep enough to reach the bottom of all ruts and depressions resulting from the compaction. The surface then shall be thoroughly rolled with steel-wheeled rollers and/or pneumatic tired rollers. A motor patrol shall then tight blade the surface wasting the cuttings. Rolling shall continue until all rutting ceases and until the upper surface of the base conforms to the density requirements specified above. During compaction of the surface, the mulch shall be moistened sufficiently to insure proper compaction and a closely knit surface. The surface finishing shall be completed within two (2) hours after the completion of the compaction specified above.

(8) **Construction Joints.** A straight transverse construction joint shall be formed at the end of each day's construction by cutting back into the completed work to form a true vertical face.

When the width of the machine, or machines, is less than the width of the roadway lane being processed, the work shall be carried forward in successive increments so the lane may be compacted and finished for the full width in one operation, and the end of each day's run will be in a single straight line at right angles to the centerline of the roadway. Widths of base construction lanes shall be approved by the engineer in order to expedite the movement of traffic during construction.



The longitudinal joint for the construction lane shall be formed by cutting back into the completed work to form a true vertical face, free of loose and shattered material.

Any finished portion of the base course, adjacent to construction, which is traveled by equipment used in constructing an adjoining section shall be protected in such a manner as to prevent equipment from marring or damaging the completed work.

**22.35 GENERAL REQUIREMENTS. (1) Construction Limitations.** Cement shall be applied only to such an area that all the operations specified can be continuous and can be completed during daylight hours. When any of these operations, after the application of cement, are interrupted for more than two (2) hours for any reason, or when the uncompacted soil-cement mixture is wetted by rain so that the average moisture content during compaction exceeds the tolerance specified under Paragraph (5), Article 22.34, the entire section shall be reconstructed in accordance with these specifications, except that the quantity of cement to be added to the previously processed soil-cement mixture shall be fifty (50) percent of the amount originally specified. The contractor shall receive no additional compensation for such reconstruction, or for the additional cement required.

**(2) Weather Limitations.** No soil-cement stabilization work shall be carried on during the season of probable freezing temperatures. No cement shall be applied unless the temperature is at least forty (40) degrees Fahrenheit and rising.

**(3) Surface Smoothness.** The surface of the cement stabilized base course shall be such that, when tested with a ten (10) foot straightedge placed on the surface parallel to the roadway centerline, the maximum deviation of the surface from the edge of the straightedge shall nowhere exceed three-eighths ( $3/8$ ) of an inch, nor more than one (1) inch from a string line stretched between grade stakes at forty (40) foot intervals. Patching of the surface will not be permitted. After compaction and finishing has been completed, and no later than the beginning of the next calendar day after the construction of each section of base, surface irregularities not conforming to the requirements specified above shall be immediately corrected with a blade adjusted to the lightest cut and the material removed shall be wasted on the shoulders. If practicable, these operations shall be done at the end of each day's work.

**(4) Thickness.** The thickness of the finished soil-cement will be determined from measurements taken in test holes drilled at intervals not to exceed five-hundred (500) feet. The average thickness of base constructed during one (1) day, shall be within one-half ( $1/2$ ) inch of the thickness shown on the plans, and the thickness at any one place shall not vary more than three-fourths ( $3/4$ ) of an inch from that shown on the plans. Where the average thickness shown by

the measurements made in one (1) day's construction is not within the tolerance given above or limited areas vary in excess of three-fourths ( $3/4$ ) of an inch from the plan thickness, the contractor shall reconstruct the day's work or the deficient areas, as the case may be. No extra compensation will be allowed for this reconstruction.

**(5) Protection and Curing.** Immediately after the operations set forth in Paragraphs (3) and (4) have been completed, the base shall be covered and protected against rapid drying with an application of curing seal. (See Paragraph (4), Article 22.32). The curing seal shall be applied at a rate of approximately two-tenth (0.2) gallon per square yard and covered with cover material, as specified in Paragraph (5), Article 22.32, at a rate of approximately fifteen (15) pounds per square yard. The exact rate of application of the curing seal and the cover material shall be as directed by the engineer to give complete coverage without excessive run-off. The surface of the base shall be kept continuously damp between the time of the final completed compaction and the application of the curing seal.

At the time of the application of the curing seal, the surface of the base shall be tightly knit, free of all loose material, and shall contain sufficient moisture to prevent penetration of the asphalt. If necessary to insure this, sufficient water to fill the surface voids shall be applied immediately before the curing seal is applied. Any areas which absorb the curing seal within twenty-four (24) hours after application shall be cleaned to hard soil-cement base, remoistened if necessary and given an additional application of curing seal, as directed by the engineer.

The application of the curing seal, together with the one application of cover material, shall conform to the applicable provisions of Section 36, "Bituminous Seal Coat."

**(6) Maintenance.** The contractor shall maintain the base to a true and satisfactory surface until the curing seal is completed. Should any repairs or patching be necessary they shall extend to the full depth of the base and shall be made in a manner to insure restoration of a uniform base course conforming to the requirements of these specifications.

**(7) Traffic.** No traffic, except that incidental to curing operations, shall be permitted on the finished base for seven (7) days after the base is compacted and the curing seal and cover has been completed.

**(8) Curing Limitations.** The wearing course shall not be placed until the cement stabilized base has cured for at least twenty-one (21) days after the curing seal has been applied.

**22.36 METHOD OF MEASUREMENT. (1) Cement.** The cement to be paid for shall be the number of barrels of three-hundred-seventy-six (376) pounds each, actually incorporated in the completed and accepted cement stabilized base. If bulk cement is used, three hundred seventy-six (376) pounds will be considered one (1) barrel.

**(2) Processing Cement Stabilized Base.** The number of square yards of processing of cement stabilized base to be paid for shall be the actual number of square yards of accepted cement stabilized base, measured complete in place, including rolling.

**(3) Soil Aggregate.** The soil aggregate shall be measured by the cubic yard, loose measurement in the vehicle at the point of delivery on the road, or at a central mixing plant, and shall be the actual number of cubic yards of accepted material.

**(4) Watering.** Watering shall be measured by the number of one-thousand (1,000) gallon units of water actually incorporated in the cement stabilized base course in accordance with Section 15, "Watering."

**(5) Curing Seal.** The curing seal applied to the cement stabilized base course shall be measured by the gallon in accordance with Section 30, "Bituminous Material."

**(6) Cover Material.** The cover aggregate to be paid for shall be the number of tons, of two-thousand (2,000) pounds, or number of cubic yards, of cover material actually accepted and applied on the curing seal.

**22.37 BASIS OF PAYMENT. (1) Cement.** The accepted number of barrels of cement, measured as provided above, shall be paid for at the contract unit price bid per barrel for cement which price and payment shall be full compensation for furnishing, hauling, spreading and for all equipment, tools, labor and incidentals necessary to complete the item.

**(2) Processing of Cement Stabilized Base.** The accepted yardage of processing of cement stabilized base, measured as provided above shall be paid for at the contract unit price bid per square yard for processing of cement stabilized base which price and payment shall be full compensation for preparation of the roadbed; for scarifying, pulverizing and drying the soil (if required) for mixing and remixing the soil, cement and water; for shaping and compaction of the mixture; for reconstruction of deficient sections; for finishing; for application of curing seal; for all protection, cover and maintenance of the completed stabilized base; and for all equipment, labor, tools and incidentals necessary to complete the item.

**(3) Soil Aggregate.** The accepted number of cubic yards of soil aggregate, measured as provided above shall be paid for at the contract unit price bid per cubic yard for soil aggregate which price and payment shall be full compensation for furnishing soil aggregate, loading, and placing on the

roadway, and for all equipment, tools, and incidentals necessary to complete the item. No additional compensation will be allowed for stripping, removal of overburden or other work at the source necessary for obtaining acceptable soil aggregate material.

(4) **Cover Material.** The accepted number of tons, or cubic yards, of cover material, measured as provided above, shall be paid for at the contract unit price bid for cover material, as provided under Section 36, "Seal Coat."

(5) **Watering.** The accepted number of one-thousand (1,000) gallon units of water, measured as provided above, shall be paid for at the unit contract price bid for watering, in accordance with Section 15, "Watering."

(6) **Curing Seal.** The accepted number of gallons of curing seal, as provided above, will be paid for by the gallon or ton, in accordance with Section 30, "Bituminous Material."

Item Number	Item Description	Unit
2231	Portland Cement	Barrel
2232	Processing Soil Cement-6"	Square Yard
2233	Processing Soil Cement-7"	Square Yard
2234	Processing Soil Cement-8"	Square Yard
2235	Processing Soil Cement-9"	Square Yard
2236	Processing Soil Cement-10"	Square Yard
2240	Soil Aggregate	Cubic Yard

Specifications for the treatment and methods listed below will be developed as required.

Subsection 22.50—Soil Bituminous Stabilization

Subsection 22.70—Sand Cement Stabilization

Subsection 22.90—Sand Bituminous Stabilization



## SECTION 23

### SELECTED BORROW BASE COURSE





**23.01 DESCRIPTION.** "Selected Borrow Base Course" shall consist of one or more courses of aggregate conforming to the gradation specified by the proposal and/or shown on the plans, constructed on the roadway in conformity with these requirements and the specifications and plans.

**23.02 MATERIAL.** (a) "Selected Borrow Base Course" shall be composed of pit run gravel, talus rock, quarry rock, dis-integrated granite, sand, sand stone, slag, scoria, shale or other similar materials, conforming to the requirements of this specification and those of Paragraph (a), Article 20.02, "Material" of Section 20, "Aggregate Surfacing—General Conditions."

As determined by A.A.S.H.O. Methods T-11 and T-27, the material shall, for the grading specified in the proposal, including any binder or filler which may have been added at the plant or on the roadway, meet the requirements of that grading in the table of gradations.

**TABLE OF GRADATIONS**

**PERCENTAGES BY WEIGHT PASSING, SQUARE-MESH SIEVES—T-27**

Passing	Grading 1	Grading 2 Crushed	Grading 3 Crushed	Grading 4 Crushed	Grading 5 Crushed	Grading 6 Crushed
4 Inch .....	100%	100%				
3 Inch .....	---	-----	100%			
2½ Inch .....	---	-----	-----	100%		
2 Inch .....	---	-----	-----	-----	100%	
1½ Inch .....	---	-----	-----	-----	-----	100%
No. 4 Sieve.....	25-60%	25-60%	25-60%	25-60%	25-60%	25-60%
No. 200 Sieve						
Less Than ....	15%	15%	15%	15%	15%	15%

That material passing the maximum screen opening and retained on the No. 4 sieve shall be uniform in grading between those limits within 5%.

The material passing the No. 40 sieve shall not have a liquid limit in excess of twenty-five (25), nor a plasticity index in excess of six (6), as determined by A.A.S.H.O. Methods T-89, T-90 and T-91, provided however, that material having a zero or non-plastic plasticity index may have a liquid limit of not to exceed thirty (30).

(b) Binder or filler, if required and/or stipulated, shall conform to the requirements of Paragraph (b), Article 20.02, "Material," of Section 20.

**23.03 PRODUCTION METHODS.** (Supplemental) (a) Grading 1: If the material source contains more than fifteen (15) per cent of oversize material, it shall be removed by passing the material over a screen or other device capable of removing oversize at the source. If the pit run material contains less than fifteen (15) percent oversize, screening will not be required providing the contractor removes all oversize which protrudes above the grade line of the finished roadway surface section and disposes of it as directed.

(b) Gradings 2, 3, 4, 5 and 6 of selected borrow base course shall be taken from sources specified acceptable for grading 1 except that all oversize material passing a screen having 10-inch square openings shall be passed through a crushing unit and reduced to the respective maximum grading limits.

**23.04 to 23.09 (Inclusive) EQUIPMENT, PRODUCTION METHODS, CONSTRUCTION METHODS, SURFACE SMOOTHNESS, METHODS OF MEASUREMENT AND BASIS OF PAYMENT,** shall apply to the methods of production, placing, measurement and payment of selected borrow base course and conforming to the requirements respectively of Articles 20.03 to 20.08, inclusive, of Section 20, except as herein supplemented and modified.

Item Description	Unit	Item No.	Unit	Item No.
Selected Borrow Base Course—				
Grade 1	Cubic Yd.	2311	Ton	2321
Selected Borrow Base Course—				
Grade 2	Cubic Yd.	2312	Ton	2322
Selected Borrow Base Course—				
Grade 3	Cubic Yd.	2313	Ton	2323
Selected Borrow Base Course—				
Grade 4	Cubic Yd.	2314	Ton	2324
Selected Borrow Base Course—				
Grade 5	Cubic Yd.	2315	Ton	2325
Selected Borrow Base Course—				
Grade 6	Cubic Yd.	2316	Ton	2326





**SECTION 24**

**CRUSHED BASE COURSE**



**24.01 DESCRIPTION.** "Crushed Base Course" shall consist of one or more courses of aggregate surfacing composed of the grading of material stipulated in the proposal and/or shown on the plans, constructed on the roadway in conformity with these requirements and the specifications and plans.

**24.02 MATERIAL.** (a) "Crushed Base Course" shall consist of gravel or stone, crushed to the gradation specified, including a filler of crushed stone, sand or other finely divided mineral matter. It shall conform to the requirements of Paragraph (a), Article 20.02, "Material," of Section 20, "Aggregate Surfacing—General Conditions," and to the requirements of this specification for the grading stipulated in the proposal and/or shown on the plans. That portion of the material retained on a No. 4 sieve shall be classified as coarse aggregate and that portion passing a No. 4 sieve shall be classified as fine aggregate.

As determined by A.A.S.H.O. Methods T-11 and T-27, the composite material shall, for the grading specified for use, including any binder or filler which may have been added at the plant or on the roadway, meet the requirements of that grading in the table of gradations:

### TABLE OF GRADATIONS

#### PERCENTAGES BY WEIGHT PASSING SQUARE MESH SIEVES—T-27

Passing	Grading 1	Grading 2	Grading 3	Grading 4	Grading 5
3 Inch .....	100%				
2½ Inch .....		100%			
2 Inch .....			100%		
1½ Inch .....				100%	
1 Inch .....	45-75%	45-80%	50-80%		100%
No. 4 Sieve .....	15-45%	15-50%	20-50%	25-55%	30-60%
No. 10 Sieve .....					20-50%
No. 200 Sieve Less Than .....	10	10	12	12	12

Suitability of the aggregate for its particular use shall be determined by the final gradation required for grading, as established by the engineer, within the limits allowed in the table for the particular grading specified.



The engineer may, when necessary to obtain a desired and uniform gradation, fix the maximum per cent of fine aggregate passing the No. 4 sieve within the specified limits and the contractor will not be allowed any compensation for costs incurred in the rejection of fines or adjustments required in conforming to such established limits.

The aggregate for all gradings, including any added binder or filler, shall meet the following supplemental requirements:

1. That portion of the fine aggregate passing the No. 200 sieve shall be less than one-half ( $\frac{1}{2}$ ) of that portion passing the No. 40 sieve.

2. The coarse aggregate shall not exceed a wear of forty (40) per cent at five-hundred (500) revolutions as determined by A.A.S.H.O. Method T-96 (Los Angeles Rattler Test).

3. That portion of the fine aggregate passing a No. 40 sieve shall not have a liquid limit of more than thirty (30) nor a plasticity index of more than six (6), as determined by A.A.S.H.O. Methods T-89, T-90 and T-91.

(b) Binder or filler, if required and/or stipulated, shall conform to the requirements of Paragraph (b), Article 20.02, "Material," of Section 20.

**24.03 to 24.08 (Inclusive) EQUIPMENT, PRODUCTION METHODS, CONSTRUCTION METHODS, SURFACE SMOOTHNESS, METHODS OF MEASUREMENT AND BASIS OF PAYMENT**, shall apply to the methods of production, placing, measurement and payment of crushed base course and conforming to the requirements respectively of Subsections 20.03 to 20.08, inclusive, of Section 20, except as herein supplemented or modified.

Item Description	Unit	Item No.	Unit	Item No.
Crushed Base Course—Grade 1	Cubic Yd.	2411	Ton	2421
Crushed Base Course—Grade 2	Cubic Yd.	2412	Ton	2422
Crushed Base Course—Grade 3	Cubic Yd.	2413	Ton	2423
Crushed Base Course—Grade 4	Cubic Yd.	2414	Ton	2424
Crushed Base Course—Grade 5	Cubic Yd.	2415	Ton	2425





## SECTION 25

### CRUSHED TOP SURFACING



**25.01 DESCRIPTION.** Types "A" and "B" "Crushed Top Surfacing" shall consist of one or more courses of aggregate surfacing composed of the type and grading of material stipulated in the proposal and/or shown on the plans, constructed on the roadway in conformity with these requirements and the specifications and plans.

**25.02 MATERIAL** (a) Type "A" or "B" surfacing shall consist of gravel or stone, crushed to the gradation specified for the type and grading, including a filler of crushed stone, sand or other finely divided mineral matter. Each type shall conform to the requirements of Paragraph (a), Article 20.02, "Material," of Section 20, "Aggregate Surfacing—General Conditions," and to the particular specifications for the type and grading stipulated in the proposal and/or shown on the plans.

That portion of the material retained on a No. 4 sieve shall be classified as coarse aggregate and that portion passing a No. 4 sieve shall be classified as fine aggregate. As determined by A.A.S.H.O. Methods T-11 and T-27, the composite material shall, for the grading specified for use in either type, including any binder or filler which may have been added at the plant or on the roadway, meet the requirements of that grading in the respective table of gradations.

(b) Binder or filler, if required and/or stipulated, shall conform to the requirements of Paragraph (b), Article 20.02, "Material," of Section 20.

Suitability of the aggregate for its particular use shall be determined by the final gradation required for any type or grading, as established by the engineer, within the limits allowed in the tables for the particular grading specified.

The engineer may, when necessary to obtain a desired and uniform gradation, fix the maximum or minimum percent of fine aggregate passing the No. 4 sieve within the specified limits and the contractor will not be allowed any compensation for costs incurred in the rejection of fines or adjustments required in conforming to such established limits.

The coarse aggregate of any type and grading shall not exceed a wear of fifty (50) percent at five-hundred (500) revolutions, as determined by A.A.S.H.O. Method T-96 (Los Angeles Rattler Test).

# **TYPE "A" CRUSHED TOP SURFACING TABLE OF GRADATIONS**

**PERCENTAGES BY WEIGHT PASSING SQUARE MESH SIEVES—T-27**

Passing	Grading 1	Grading 2	Grading 3	Grading 4	Grading 5
1 Inch Sieve .....	100%				
3/4 Inch Sieve .....		100%			
5/8 Inch Sieve .....			100%		
1/2 Inch Sieve .....				100%	
3/8 Inch Sieve .....					100%
No. 4 Sieve .....	40-70%	40-70%	40-70%	40-70%	50-80%
No. 10 Sieve .....	25-55%	25-55%	25-55%	25-60%	35-70%
No. 200 Sieve .....	2-10%	2-10%	2-10%	2-10%	2-10%

The aggregate for all gradings, including any added binder or filler, shall meet the following supplemental requirements:

1. That portion of the fine aggregate passing the No. 200 sieve shall be less than sixty (60) percent of that portion passing the No. 40 sieve.

2. Aggregate shall be so graded within the limits given in the table that at least ten (10) percent of the total aggregate shall pass a No. 4 sieve and be retained on a No. 10 sieve.

3. That portion of the fine aggregate passing a No. 40 sieve shall not have a liquid limit of more than thirty (30) nor a plasticity index of more than six (6), as determined by A.A.S.H.O. Methods T89, T-90 and T-91.

4. The composite aggregate shall be free from adherent films of clay or other matter that will prevent thorough coating with bituminous material. It shall be of such nature that the coating of bituminous material will not slough off upon contact with water.

5. The composite aggregate to be bituminized shall not have a swell of more than fifteen (15) percent in eight (8) days and shall show no cracking or disintegration when tested for volume swell and water absorption by A.S.T.M. Modified Method D915-47T.

6. No intermediate sizes of aggregate, for cover aggregate and/or other purposes, shall be removed from the material in the course of production unless authorized, in writing, by the engineer.



### TYPE "B" CRUSHED TOP SURFACING TABLE OF GRADATIONS

Percentages By Weight Passing	Square Mesh Sieves	AASHTO—T-27
Grading 1	Grading 2	Grading 3
1½ Inch Sieve .....	100%	
1 Inch Sieve .....	100%	
¾ Inch Sieve .....		100%
No. 4 Sieve .....	40-80%	40-80%
No. 10 Sieve .....	25-60%	25-60%
No. 200 Sieve .....	5-20%	5-20%

The aggregate for all gradings, including any added binder or filler, shall meet the following supplemental requirements:

1. That portion of the fine aggregate passing the No. 200 sieve shall be less than two-thirds (2/3) of that portion passing the No. 40 sieve.

2. That portion of the fine aggregate passing a No. 40 sieve shall not have a liquid limit of more than thirty-five (35) and a plasticity index which may vary from non-plastic to nine (9), as determined by A.A.S.H.O. Methods T-89, T-90 and T-91.

**25.03 to 25.08 (Inclusive) EQUIPMENT, PRODUCTION METHODS, CONSTRUCTION METHODS, SURFACE SMOOTHNESS, METHODS OF MEASUREMENT AND BASIS OF PAYMENT** shall apply, except as herein supplemented and modified, to the methods of production, placing, measurement and payment of Types "A" and "B" crushed top surfacing and conforming to the requirements respectively of Articles 20.03 to 20.08, inclusive, of Section 20, "Aggregate Surfacing—General Conditions."

Item Description	Unit	Item No.	Unit	Item No.
Type "A" Crushed Top Surfacing—				
Grading 1	Cubic Yd.	2501	Ton	2511
Type "A" Crushed Top Surfacing—				
Grading 2	Cubic Yd.	2502	Ton	2512
Type "A" Crushed Top Surfacing—				
Grading 3	Cubic Yd.	2503	Ton	2513
Type "A" Crushed Top Surfacing—				
Grading 4	Cubic Yd.	2504	Ton	2514
Type "A" Crushed Top Surfacing—				
Grading 5	Cubic Yd.	2505	Ton	2515
Type "B" Crushed Top Surfacing—				
Grading 1	Cubic Yd.	2521	Ton	2531
Type "B" Crushed Top Surfacing—				
Grading 2	Cubic Yd.	2522	Ton	2532
Type "B" Crushed Top Surfacing—				
Grading 3	Cubic Yd.	2523	Ton	2533



**SECTION 26**

**BINDER OR FILLER**



**26.01 DESCRIPTION.** "Binder" or "Filler" shall consist of fine natural soil particles or crusher dust, free from grass, roots, weeds, humus or other undesirable matter. Its binder and/or filler properties shall be such that, when added and blended with any type of aggregate surfacing material, it will provide the final product with the physical structure and properties required of the particular specifications.

**26.02 MATERIAL.** Sources of binder or filler will be indicated in the proposal and/or shown on the plans or designated by the engineer. The State will furnish this material in its original position, royalty free, to the contractor, except in cases where the material can be obtained within a distance of one-thousand (1,000) feet from the contractor's crushing and/or screening plant and is added at the plant. In this case, the additional binder or filler will be considered an integral part of the surfacing material and shall be supplied by the contractor without additional cost to the State.

If any aggregate surfacing material is deficient in binding quality, or grading characteristics, an approved amount of binder or filler shall be added, provided, however, that the grading of the final mixture shall not exceed the limits specified for the particular type and grading of aggregate surfacing.

No binder or filler shall be added, either upon the roadway or through the plant, until tests have been completed and the material approved for use by the laboratory.

Quantities of binder, or filler, and overhaul thereon, when included in the proposal form, are not guaranteed to be used or required and the department reserves the right to increase, decrease or omit all or any part of these items and no compensation will be allowed by reason thereof.

**26.03 CONSTRUCTION METHODS.** Binder or filler, when required, may be added at the plant or on the roadway. If added on the roadway, the binder or filler shall be spread uniformly across the roadway over the loosely spread surfacing course layer in the amounts as directed. It shall then be thoroughly blended and mixed into the surfacing material by approved methods and equipment. Where the depth of the course is three (3) inches or less, unless otherwise specified, the binder or filler shall be processed into the entire depth. Where the depth of the course exceeds three (3) inches, the binder or filler shall be processed into not less than the upper three (3) inches.

**26.04 METHOD OF MEASUREMENT.** (a) Binder or filler which has been added to the surfacing material after it has been placed upon the roadway will be measured in accordance with the appropriate requirements of Article 20.07, "Method of Measurement" of Section 20, "Aggregate Surfacing—General Conditions."

(b) Haul on binder or filler will be measured in accordance with the appropriate requirements of Articles 12.02 and 13.02, "Method of Measurement," respectively, of Section 12, "Overhaul" and Section 13, "Haul."

**26.05 BASIS OF PAYMENT.** (a) Binder or filler will be paid for at the contract unit bid price, which price and payment, except as otherwise expressly provided, will be full compensation for all material, labor, equipment, tools and incidentals necessary to complete the item and for all work, equipment and incidentals necessary in stripping overburden and restoring the source from which binder or filler has been obtained to a status satisfactory to the property owner and the engineer.

(b) Haul on binder or filler will be paid for at the contract unit bid price, which price and payment will be full compensation for hauling all materials, and for all equipment, tools, labor and incidentals necessary to complete the work.

Item Description	Unit	Item No.	Unit	Item No.
Binder	Cubic Yard	2611	Ton	2612
Filler	Cubic Yard	2621	Ton	2622







## **SECTION 27**

### **CRUSHED COVER AGGREGATE**



**27.01 DESCRIPTION.** "Crushed Cover Aggregate" shall consist of cover material or stone chips meeting the requirements of these respective specifications and of Article 20.02, "Material," of Section 20, "Aggregate Surfacing—General Conditions." It shall either be placed on the roadway or stockpiled in conformity with the plans and specifications.

**27.02 MATERIAL.** (a) **Cover Material** shall conform to all the requirements of Type "A" top surfacing as set forth in Section 25, "Crushed Top Surfacing," modified to meet the gradation requirements of the grading stipulated in the proposal.

As determined by A.A.S.H.O. Methods T-11 and T-27, the cover material shall meet the specified grading requirements of that grading in the table of gradations for cover material.

### TABLE OF GRADATIONS FOR COVER MATERIAL

Percentages By Weight Passing Square Mesh Sieves AASHO—T-27

Passing	Grading 1	Grading 2	Grading 3
$\frac{5}{8}$ Inch Sieve .....	100%		
$\frac{1}{2}$ Inch Sieve .....		100%	
$\frac{3}{8}$ Inch Sieve .....			100%
No. 4 Sieve .....	9-33%	9-50%	9-50%
No. 10 Sieve .....	0-8 %	0-8 %	0-8 %
No. 200 Sieve .....	0-2 %	0-2 %	0-2 %

(b) **Stone Chips.** The material for this item shall be screenings of crushed stone or crushed aggregate. It shall consist of clean, durable fragments free from an excess of flat, elongated, soft or disintegrated pieces, clay balls or other objectionable material. Chips as produced shall have a clean, crisp appearance and be free from adherent films of clay or rock dust and shall be washed thoroughly unless otherwise provided in the proposal. They shall not exceed a wear of more than forty (40) percent at five-hundred (500) revolutions as determined by A.A.S.H.O. Method T-96 (Los Angeles Rattler Test). The abrasion test shall be run using a five-thousand (5,000) gram sample charge of material between the three-eighths ( $\frac{3}{8}$ ) inch and No. 4 sieves and an abrasive charge of eight (8) balls.

Stone chips shall consist of the product obtained by crushing and screening material that has first been screened in such a manner that not less than ninety-five (95) percent of the material for crushing, when tested by laboratory methods, is retained on a sieve having openings one (1) inch square.

When tested by A.A.S.H.O. Methods T-11 and T-27 in conjunction with a water wash, chips shall meet the specified grading requirements of that grading in the table of gradations for stone chips.

**TABLE OF GRADATIONS FOR STONE CHIPS**

Percentages By Weight Passing Square Mesh Sieves AASHO—T-27

Passing	Grading 1	Grading 2	Grading 3
½ Inch Sieve .....	100%		
¾ Inch Sieve .....		100%	
No. 4 Sieve .....	0-20%	0-20%	100%
No. 10 Sieve .....	0-2 %	0-2 %	0-2%

**27.03 EQUIPMENT AND 27.04 PRODUCTION METHODS.**

Equipment and production methods for crushed cover aggregate shall meet the requirements of Articles 20.03, "Equipment," and 20.04, "Production Methods," of Section 20.

**27.05 CONSTRUCTION METHODS.** If crushed cover aggregate is to be stockpiled at designated locations, the stockpiling shall be accomplished in accordance with the requirements of Section 28, "Stockpiled Surfacing Aggregate." If crushed cover aggregate is to be placed on the roadway, the work shall be in accordance with the requirements, as the case may be, of either Section 36, "Seal Coat," or Section 33, "Bituminous Surface Treatment."

**27.06 METHOD OF MEASUREMENT.** Crushed cover aggregate will be measured in accordance with the appropriate requirements of Article 20.07, "Method of Measurement," of Section 20.

**27.07 BASIS OF PAYMENT.** Cover material or stone chips will be paid for at the contract unit bid price placed in the stockpile or complete in place on the roadway, as may be specified, which price and payment, unless otherwise provided, will be full compensation for furnishing, producing and placing all materials including all labor, equipment, hauling, tools, all manipulations and incidentals necessary to complete the respective items. Payment shall be made in accord with the provisions of the proposal form and the list of items at the end of this section.

**27.08 DISPOSAL OF EXCESS CRUSHED COVER AGGREGATE.** When the contract provides that crushed cover aggregate shall be in place on the roadway, it is not ordinarily feasible to crush out the exact amount required. The State will purchase any unused crushed cover aggregate up to a maximum amount equivalent to the difference in the tonnage set forth in the contract and the tonnage actually used on the roadway. The State will purchase such excess material in accordance with the following schedule, plus ten (10) cents per ton mile of haul if the cover material is stockpiled more than two-thousand (2,000) feet from the crusher.

	Grading 1	Grading 2	Grading 3	
<b>Cover Material</b> .....	\$1.50	\$1.75	\$2.00	Per Ton
<b>Stone Chips</b> .....	\$2.00	\$2.25	\$2.50	Per Ton

If the unit price bid for cover material or stone chips in place is less than the amount listed for the respective item, the State will compensate the contractor at his unit price bid.

Purchase of the excess crushed cover aggregate will be at the contractor's option. If the contractor does not elect to dispose of the material at the herein-scheduled prices, it shall remain the contractor's property but it shall be removed from State premises, and the State will disclaim further responsibility in the matter

Item Description	Unit	Item No.	Unit	Item No.
Cover Material—Grading 1	Cubic Yard	2711	Ton	2716
Cover Material—Grading 2	Cubic Yard	2712	Ton	2717
Cover Material—Grading 3	Cubic Yard	2713	Ton	2718
Stone Chips—Grading 1	Cubic Yard	2721	Ton	2726
Stone Chips—Grading 2	Cubic Yard	2722	Ton	2727
Stone Chips—Grading 3	Cubic Yard	2723	Ton	2728



## **SECTION 28**

# **STOCKPILED SURFACING AGGREGATE**





**28.01 DESCRIPTION.** This specification provides for the production and/or stockpiling of any type of aggregate surfacing at the sites designated in the proposal and/or shown on the plans and/or as directed.

**28.02 MATERIAL.** The material shall conform to the requirements of Article 20.02, "Material," of Section 20, "Aggregate Surfacing—General Conditions," and to the particular specifications for the type and grading stipulated in the proposal and/or shown on the plans.

**28.03 EQUIPMENT.** Equipment shall meet the requirements of Article 20.02, "Equipment," of Section 20.

**28.04 CONSTRUCTION METHODS.** The contractor shall produce and/or deliver and place the specified material in stockpiles at the designated sites. The stockpile sites shall be cleared of weeds, roots, stumps, rocks or any other matter which might contaminate the material. The piles shall be constructed as directed by the engineer. Stockpiles shall be so constructed that they will occupy a minimum area. In no instance shall they be constructed in single tiers or in single truck dump widths. Stockpile construction shall be so planned and executed that the piles will not be less than three (3) tiers in height with each tier not less than three (3) feet in height. End dumping of material over the sides of the pile shall not be permitted.

**28.05 METHOD OF MEASUREMENT.** (a) Stockpiled material will be measured in accordance with the appropriate requirements of Article 20.07, "Method of Measurement," of Section 20.

(b) Haul, when specified, will be measured in accordance with the appropriate requirements of Section 12, "Overhaul," and Section 13, "Haul."

**28.06 BASIS OF PAYMENT.** (a) Stockpiled material will be paid for at the contract unit bid price, which price and payment, except as otherwise specified, will be full compensation for all materials, production, labor, equipment, tools, all manipulations and incidentals necessary to complete the work.

(b) Haul will be paid for at the contract unit bid price in accordance with the appropriate requirements of Section 12 and 13, "Overhaul" and "Haul," respectively.

All items listed below are "Stockpiled." For "Non-participating" stockpiled material see Section 99.

Item Description	Unit	Item No.	Unit	Item No.
Selected Surfacing—				
Grade 1	Cubic Yd.	2801	Ton	2811
Selected Surfacing—				
Grade 2	Cubic Yd.	2802	Ton	2812
Selected Surfacing—				
Grade 3	Cubic Yd.	2803	Ton	2813
Selected Surfacing—				
Grade 4	Cubic Yd.	2804	Ton	2814
Selected Surfacing—				
Grade 5	Cubic Yd.	2805	Ton	2815
Selected Surfacing—				
Grade 6	Cubic Yd.	2806	Ton	2816
Aggregate Mixture—				
	Cubic Yd.	2809	Ton	2819
Selected Borrow Base Course—				
Grade 1	Cubic Yd.	2821	Ton	2831
Selected Borrow Base Course—				
Grade 2	Cubic Yd.	2822	Ton	2832
Selected Borrow Base Course—				
Grade 3	Cubic Yd.	2823	Ton	2833
Selected Borrow Base Course—				
Grade 4	Cubic Yd.	2824	Ton	2834
Selected Borrow Base Course—				
Grade 5	Cubic Yd.	2825	Ton	2835
Selected Borrow Base Course—				
Grade 6	Cubic Yd.	2826	Ton	2836
Crushed Base Course—				
Grade 1	Cubic Yd.	2841	Ton	2851
Crushed Base Course—				
Grade 2	Cubic Yd.	2842	Ton	2852
Crushed Base Course—				
Grade 3	Cubic Yd.	2843	Ton	2853
Crushed Base Course—				
Grade 4	Cubic Yd.	2844	Ton	2854
Crushed Base Course—				
Grade 5	Cubic Yd.	2845	Ton	2855
Type "A" Top Surfacing—				
Grading 1	Cubic Yd.	2861	Ton	2871

Item Description		Unit	Item No.	Unit	Item No.
Type "A" Top Surfacing—					
Grading 2	Cubic Yd.	2862	Ton	2872	
Type "A" Top Surfacing—					
Grading 3	Cubic Yd.	2863	Ton	2873	
Type "A" Top Surfacing—					
Grading 4	Cubic Yd.	2864	Ton	2874	
Type "A" Top Surfacing—					
Grading 5	Cubic Yd.	2865	Ton	2875	
Type "B" Top Surfacing—					
Grading 1	Cubic Yd.	2867	Ton	2877	
Type "B" Top Surfacing—					
Grading 2	Cubic Yd.	2868	Ton	2878	
Type "B" Top Surfacing—					
Grading 3	Cubic Yd.	2869	Ton	2879	
Cover Material—					
Grading 1	Cubic Yd.	2881	Ton	2891	
Cover Material—					
Grading 2	Cubic Yd.	2882	Ton	2892	
Cover Material—					
Grading 3	Cubic Yd.	2883	Ton	2893	
Stone Chips—					
Grading 1	Cubic Yd.	2884	Ton	2894	
Stone Chips—					
Grading 2	Cubic Yd.	2885	Ton	2895	
Stone Chips—					
Grading 3	Cubic Yd.	2886	Ton	2896	

See Section 99 for stockpiled materials where there is no Federal Aid participation in the cost.



## **SECTION 30**

### **BITUMINOUS MATERIALS**

**(Section 31 is contiguous with Section 30)**



**30.01 DESCRIPTION.** This section sets forth the requirements for all types and grades of bituminous material for use in bituminous surfacing and/or allied purposes. All bituminous material used in the completed and accepted work shall meet the requirements for the particular type and grade stipulated in the proposal. Conjunction Section 31 is functional only for administrative purposes.

**30.02 MATERIAL.** Bituminous materials shall conform to the following requirements except, as may be herein supplemented or modified:

(a) Asphalt cement shall conform to the requirements of A.A.S.H.O. Designation: M-20. See Table 30-M-20.

(b) Cutback asphalt, Rapid Curing type (RC), shall conform to the requirements of A.A.S.H.O. Designation: M-81. See Table 30-M-81.

(c) Cutback asphalt, medium curing type (MC), shall conform to the requirements of A.A.S.H.O. Designation: M-82. See Table 30-M-82.

(d) Liquid asphaltic material, slow curing type (SC), shall conform to the requirements of A.A.S.H.O. Designation: M-141. See Table 30-M-141.

(e) Emulsified asphalt shall conform to the requirements of A.A.S.H.O. Designation: M-140. See Table 30-M-140. Testing shall conform to the provisions of A.A.S.H.O. Method T-59 (A.S.T.M. D-244).

(f) Rubberized rapid curing cutback asphalt shall conform to the specifications set forth in Table 30-LBF-T (1956).

All tables referred to above will be found at the end of this section.

Any other type of bituminous material, when stipulated in the proposal, shall conform to the pertinent requirements of the A.A.S.H.O. designation for the particular material.

A.S.T.M. Method D-165 shall be used in determining the percent bitumen soluble in carbon tetrachloride.

All asphalt cements and the residues from the distillation of all other bituminous materials shall be negative when tested with thirty-five (35) percent xylene in the Heptane-Xylene Equivalent Test, A.A.S.H.O. Designation: T-102.

Other bituminous materials of particular specification, which are not shown herein, may be developed upon requirement of the plans.

**30.03 GENERAL REQUIREMENTS.** (a) **Source.** The source of bituminous material shall be approved by the engineer before shipments are made to any project and the source of supply shall not be changed after work is started, unless specifically permitted by the engineer in writing. The contractor shall not order delivery of bituminous material without approval of the engineer and the engineer will not be liable for the quantity shipped.



Material delivered to a project shall maintain a uniformity of test results which shall not vary more than five (5) percent, unless a change is ordered by the engineer. When bituminous material being used in the work meets requirements but fails to maintain the specified uniformity of test results, use of that material shall be terminated until such time as uniformity is reestablished.

**(b) Sampling.** Samples of bituminous materials may be taken from shipments at the source and/or at the point of delivery, as directed by the engineer. In no case shall any bituminous material be used until accepted by the laboratory. Sampling shall be performed in conformance with A.A.S.H.O. Method T-40.

**(c) Shipping.** The supplier furnishing bituminous material shall carefully inspect each tank car or tank truck before it is loaded and ship only in clean, uncontaminated, fully insulated cars or trucks, sealed after loading by the supplier.

**(d) Testing.** Each car load or truck load of bituminous material ordered by a contractor must be sampled and tested before the material is used in the work.

The State will, whenever practicable, make arrangements for pretesting bituminous material at the source of supply by an inspector from the State Highway Laboratory or an inspector from an approved commercial testing laboratory employed by the State.

The State representative shall have the use of laboratory facilities at the source of supply and shall be allowed the privilege of inspecting all tank cars and tank trucks and process of refining relating to the material which is being supplied.

The State representative will gauge all shipments of bituminous material and issue certificates of delivery, showing type, grade and quantity of material shipped, as well as reports showing test results, when available. Each shipment shall be accompanied by a delivery certificate.

In any case where pre-testing has not been arranged for by the State, the supplier of the bituminous material shall issue, in duplicate, certified test reports showing full compliance with the specification requirements for the designated grade of material, together with the following information: Project number, date of shipment, source of the material, car or truck initial and number, destination, gross quantity loaded, loading temperature, and net quantity in gallons at 60° F., or tons, whichever unit of measurement is stipulated. One certified report shall be sent to the engineer on the project and one report to the State Laboratory at Helena. Suppliers' tests will be subject to check by the State Laboratory before the material is used.

Specifications and test procedures for bituminous material, except as herein modified, shall be in accordance with current A.A.S.H.O. specifications and tests.

The engineer reserves the right to adopt the latest revisions of any of the test procedures herein specified.

(e) **Acceptance.** Bituminous materials will be accepted on the basis of the results of tests which meet all the specified requirements, and which are made on samples selected and tested by the State or its authorized representative.

The engineer may permit the use of bituminous materials before completion of all tests required, provided the results of tests for materials previously furnished by the refinery have been consistently satisfactory.

Permission for use of bituminous materials before completion of all tests, as outlined herein, shall not be considered as a waiver of the right to reject materials which, upon completion of the tests, fail to meet the requirements of these specifications.

Permission for use before completion of tests, as provided herein, may be discontinued whenever the material fails to meet specification requirements. Permission for use before completion of tests will not be resumed until the material being furnished again consistently satisfies specified requirements.

(f) **Loading and Application Temperatures.** Bituminous materials shall be applied at temperatures which will assure uniform mixing or spreading and the temperatures will be designated by the engineer. Recommended application temperature ranges for the various kinds and grades of bituminous materials are listed in the following table. Bituminous materials shall not be reheated and loaded at temperatures exceeding the maximum application temperature unless expressly permitted by the engineer. Only at the refinery source may loading temperatures of not to exceed 50° F. greater than the listed maximums be used.

Type and Grade of Bitumen	Application Temperature		Type and Grade of Bitumen	Application Temperature	
	Min. °F.	Max. °F.		Min. °F.	Max. °F.
RC-0	50	125	MC-0	50	125
RC-1	100	150	MC-1	100	175
RC-2	125	175	MC-2	125	200
RC-3	150	200	MC-3	175	250
RC-4	175	225	MC-4	200	275
RC-5	200	250	MC-5	225	275
SC-0	50	125	Asphalt Cement		
SC-1	100	175	50-200	275	350
SC-2	150	225	200-350	250	350
SC-3	200	300			
SC-4	225	325	Fmulsified		
SC-5	250	350	Asphalt	100	150
SC-6	250	350			

The foregoing temperatures also shall apply, generally, to central plant mixes. Temperatures of mixtures produced in pug mills shall not be greater than necessary for hauling and placing and aggregate temperatures at the time of mixing shall be regulated accordingly. Aggregate temperatures shall not exceed the maximum temperature listed in the table of temperatures recommended for the bituminous material with which it is to be mixed, or 325° F., whichever is lowest. In no case shall the aggregate be introduced into a pug mill at a temperature of more than 25° above the temperature of the bituminous material.

**(g) Alternate Type of Grade of Bituminous Materials.** The State reserves the right to change or substitute the type or grade of bituminous material to be used, depending on seasonal or other conditions; and in case of such change or substitution, a supplemental agreement in the form of a work order shall be executed prior to the use of the material. The basis of payment for the changed or substituted bituminous material shall be the unit price bid for the respective type or grade of bituminous material stipulated in the contract, plus or minus the difference in cost to the contractor at the refinery between the type or grade stipulated in the contract and the changed or substituted type or grade.

**30.04 METHOD OF MEASUREMENT.** Bituminous material will be measured by the U. S. gallon or by the ton, as stipulated in the proposal.

**(a)** If measured by the gallon, the volume shall be determined at a temperature of 60° F., or corrected to this basis by means of the appropriate group table as designated in Volume Correction Tables, A.S.T.M. D-1250.

Bituminous materials, when measured by the gallon, shall be transported in tanks previously certified as to their capacity and each tank shall be accompanied by its proper measuring rod and calibration card. Railroad tank cars shall have available inage and outage tables and dome capacity charts.

**(b)** When measured by the ton, the weight shall be determined on scales furnished by the supplier or on public scales most accessible to the source. Each vehicle used in transporting bituminous materials, other than railroad tank cars, shall be weighed completely empty and after loading and the difference in weights used as the basis for computing the tonnage. Any scale used shall be capable of weighing the transporting unit in an unbroken operation and shall be satisfactory to the engineer. The scales shall be tested and sealed, at the expense of the supplier, as often as the engineer may consider necessary to insure their accuracy.

In the instance of plant mix operations the bituminous material may be weighed, if satisfactory to the engineer, by the plant scales.

If railroad tank cars are to be used in transporting bituminous materials, railroad-car weights will be accepted as the basis for computing the weight of bituminous material,

provided that the loaded car is weighed over track scales. The stenciled tare on the car, unless proven to be erroneous, will be used in determining the net weight.

An inspector, appointed and compensated by the State, shall be in attendance at all weighing operations to conduct or witness such operations.

Full compensation for weighing bituminous material as specified shall be considered as included in the unit price bid per ton for the bituminous material and no additional compensation will be made therefor.

**30.05 BASIS OF PAYMENT.** Bituminous material, used in the completed and accepted work, will be paid for at the contract unit bid price, which price and payment shall include all demurrage, storage, handling and other charges, all materials (including the bituminous material), tools, equipment, labor and the performance of all work necessary or incidental to the furnishing, delivering, heating, hauling, manipulating and application of the bituminous material, unless otherwise expressly provided for.

Grade	Unit	Item No.	Unit	Item No.
ASPHALT CEMENT				
50- 60 Penetration	Gallon	3010	Ton	3110
60- 70 Penetration	Gallon	3011	Ton	3111
70- 85 Penetration	Gallon	3012	Ton	3112
85-100 Penetration	Gallon	3013	Ton	3113
100-120 Penetration	Gallon	3014	Ton	3114
120-150 Penetration	Gallon	3015	Ton	3115
150-200 Penetration	Gallon	3016	Ton	3116
200-300 Penetration	Gallon	3017	Ton	3117
RAPID CURING CUTBACK ASPHALT				
RC-0	Gallon	3020	Ton	3120
RC-1	Gallon	3021	Ton	3121
RC-2	Gallon	3022	Ton	3122
RC-3	Gallon	3023	Ton	3123
RC-4	Gallon	3024	Ton	3124
RC-5	Gallon	3025	Ton	3125
MEDIUM CURING CUTBACK ASPHALT				
MC-0	Gallon	3030	Ton	3130
MC-1	Gallon	3031	Ton	3131
MC-2	Gallon	3032	Ton	3132
MC-3	Gallon	3033	Ton	3133
MC-4	Gallon	3034	Ton	3134
MC-5	Gallon	3035	Ton	3135
SLOW CURING CUTBACK ASPHALT				
SC-0	Gallon	3040	Ton	3140
SC-1	Gallon	3041	Ton	3141
SC-2	Gallon	3042	Ton	3142
SC-3	Gallon	3043	Ton	3143
SC-4	Gallon	3044	Ton	3144
SC-5	Gallon	3045	Ton	3145
SC-6	Gallon	3046	Ton	3146
EMULSIFIED ASPHALT				
RS-1	Gallon	3051	Ton	3151
RS-2	Gallon	3052	Ton	3152
MS-1	Gallon	3053	Ton	3153
MS-2	Gallon	3054	Ton	3154
MS-3	Gallon	3055	Ton	3155
SS-1	Gallon	3056	Ton	3156
PENETRATION ASPHALT—RUBBERIZED				
	Gallon	3060	Ton	3160
	Gallon	3061	Ton	3161
	Gallon	3062	Ton	3162
	Gallon	3063	Ton	3163
	Gallon	3064	Ton	3164
RUBBERIZED RAPID CURING CUTBACK ASPHALT				
RC-3D	Gallon	3065	Ton	3165
RC-4D	Gallon	3066	Ton	3166
RC-5D	Gallon	3067	Ton	3167
RC-6D	Gallon	3068	Ton	3168



## SPECIFICATION FOR ASPHALT CEMENT

TABLE 30-M-20  
(1954)

PENETRATION GRADES	40 - 120		120 - 150		150 - 200		200 - 300	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Penetration grade, as specified	40	50	120	150	150	200	200	300
Flash point, Cleveland open cup F	50	60						
Ductility at 77° F., 5 cm. per min., cm	60	70						
Loss on heating, 325° F., 5 hr., percent	70	85						
Penetration of residue from loss on heating test, at 77° F., 100 g., 5 sec., as compared to penetration before heating, percent	85	100						
Solubility in carbon tetrachloride, percent (b)	100	120						
Ash, percent	450	--	425	--	425	--	350	
Spot test (when specified) with: - (see note "a")	100	--	100	--	--	--	--	1.0
Standard naphtha solvent	--	1.0	--	1.0	--	1.0	--	
Naphtha - xylene solvent:— percent xylene	75		75		75		75	
Heptane - xylene solvent:— percent xylene	99.5		99.5		99.5		99.5	
		1.0		1.0		1.0		1.0

Negative for all Grades

- Notes: a - The use of the spot test is optional. When it is specified, the Engineer shall indicate whether standard naphtha solvent, the naphtha-xylene solvent, or the heptane-xylene solvent will be used in determining compliance with the requirement and also, in case of the xylene solvents, the percentage of xylene to be used.
- b - A. A. S. H. O. prescribes a minimum of 99% by Method T 45
- c - Petroleum asphalt shall be prepared by the distillation of asphaltic petroleum.
- d - The asphalt cement shall be homogeneous, free from water, and shall not foam when heated to 347°

SPECIFICATION FOR RAPID CURING CUT-BACK ASPHALT

TABLE 30 - M - 81

(1955)

GRADE	RC-0		RC-1		RC-2		RC-3		RC-4		RC-5	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Flash point, degree F.	75	150			80		80		80		80	
Viscosity, Saybolt - Furot at 77 F., sec.			75	150								
at 122 F., sec.												
at 140 F., sec.												
at 180 F., sec.												
Distillation test:												
Distillate, percentage by volume of total distillate to 680 F.:												
to 374 F.	15		10									
to 437 F.	55		50		40		25		8			
to 500 F.	75		70		65		55		40		25	
to 600 F.	90		88		87		83		80		70	
Residue from distillation to 680 F., percentage volume by difference	50		60		67		73		78		82	
Tests on residue from distillation:												
Penetration	80	120	80	120	80	120	80	120	80	120	80	120
Ductility, cm	100		100		100		100		100		100	
Solubility in carbon tetrachloride.	99.5		99.5		99.5		99.5		99.5		99.5	
Spot test (when specified) with (see Note 3).												
Standard naphtha solvent												
Naphtha xylene solvent, - percent xylene												
Heptane xylene solvent, - percent xylene												

Negative for all grades  
Negative for all grades  
Negative for all grades

Notes: 1 - Scope: These specifications cover liquid petroleum products, produced by fluxing an asphaltic base with a suitable light volatile solvent, to be used in the treatment of road surfaces.

2 - General Requirements: The cut-back asphalt shall be free from water and shall show no separation or curdling prior to use.

3 - The use of the spot test is optional. When specified, the Engineer shall indicate whether the standard naphtha solvent, the naphtha xylene solvent or the heptane xylene solvent will be used in determining compliance with the requirement, and also, in the case of the xylene solvents, the percentage of xylene to be used.



TABLE 30 - M - 14 I  
(1955)

## SPECIFICATION FOR SLOW CURING LIQUID ASPHALTIC ROAD MATERIAL

GRADE	SC-0		SC-1		SC-2		SC-3		SC-4		SC-5		SC-6	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Water, Percent by Volume	150	0.5	150	0.5	175	0.0	200	0.0	225	0.0	250	0.0	275	0.0
Flash Point, F.	75	150	75	150	100	200	250	500	125	250	300	600	250	500
Viscosity Saybolt Furol at 77 F., sec.														
at 122 F., sec.														
at 140 F., sec.														
at 180 F., sec.														
at 210 F., sec.														
Asphalt residue of 100 penetration, percent by weight	40		50		60		70		75		80		90	
Ductility of 100 penetration residue at 77 F.-5 cm./min. cm.	100		100		100		100		100		100		100	
Solubility in CC14, percent (see Note 3)	99.5		99.5		99.5		99.5		99.5		99.5		99.5	
Total distillate to 680 F. percent by volume	15	40	10	30	5	25	2	15	0	10	0	5	0	2
Float test of distillation residue at 122 F. sec.	15	100	20	100	25	100	50	125	60	150	75	200	150	350
Spot test (when specified) with (see Note 4)														
Standard naphtha solvent														
Naphtha xylene solvent - percent xylene														
Heptane xylene solvent, - percent xylene														

Notes: 1 - Scope: This specification covers requirements for slow curing petroleum products for use in treatment and construction of certain types of roads.

2 - General Requirements: Each shipment of oil shall be uniform in appearance and consistency and shall show no foaming when heated to 225°F. The residue of specified penetration shall be smooth and homogeneous in appearance.

3 - If material fails to meet requirement for solubility, it will be accepted if its solubility in CS2 is 99.0%+ and the proportion of bitumen soluble in CC14 is 99.65%+.

4 - The use of the spot test is optional. When specified, the engineer shall indicate whether the standard naphtha solvent, the naphtha xylene solvent, or the heptane xylene solvent is to be used in determining compliance with the requirements, and also in the case of the xylene solvents the percentage of xylene to be used.

SPECIFICATION FOR EMULSIFIED ASPHALT

TABLE 30 - M-140  
(1949)

TYPE	RS-1		RS-2		MS-1		MS-2		MS-3		MS-4		SS-1	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Viscosity, Saybold Fural A+77 F., Sec.	20	100	-	-	20	100	100	-	-	-	-	-	20	100
A+122 F., Sec.	-	-	50	300	-	-	-	-	-	-	-	-	-	-
Residue by Distillation, %	55	-	60	-	55	-	60	-	65	-	65	-	57	-
Settlement, 5 days	-	3	-	3	-	5	-	5	-	-	-	-	-	(b)
(a) Demulsibility 50 ml of 0.1 N, CaCl <sub>2</sub> %	-	-	-	-	-	45	-	45	-	-	-	-	-	-
(a) Demulsibility 35 ml. of 0.02 N, CaCl <sub>2</sub> %	30	90	60	-	-	-	-	-	-	-	-	-	-	-
Sieve Test, %	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10	-	0.05
Miscibility with Water	-	-	-	-	-	(c)	-	(c)	-	(c)	-	(c)	-	-
Coating Test	-	-	-	-	-	(d)	-	(d)	-	(d)	-	(d)	-	-
Freezing Test	-	-	-	-	-	-	-	-	-	homogeneous	-	-	-	-
Modified Miscibility with Water	-	-	-	-	-	-	-	-	-	-	-	-	-	4 5
Cement Mixing Test, %	-	-	-	-	-	-	-	-	-	-	-	-	-	2 0

RESIDUE - The residue obtained from distillation shall conform to the following requirements for all grades:

Penetration at 25 C (77) F., 100 g, 5 secs.  
100 to 200

Soluble in Carbon Disulfide:

Petroleum Asphalts, not less than

Native Asphalts, not less than

Ash, not more than

Ductility at 25 C. (77) F., not less

97.5 per cent

95 per cent

2 per cent

40 cm.

Notes. 1 - Emulsified asphalt shall be homogeneous. It shall show no separation of asphalt after thorough mixing within 30 days after delivery, provided separation has not been caused by freezing, except for Type MS-4.  
2 - At least one sample of not less than one gallon shall be taken from each lot or shipment of the emulsified asphalt after arrival at its destination. The samples shall be stored in clean, airtight glass or black-iron containers at a temperature of not less than 40° F. until tested.

a - The demulsibility test shall be made within 30 days from date of shipment.

b - If the sample of emulsified asphalt being tested fails to conform to the requirements for modified miscibility, the sample shall be tested for 5-day settlement and for miscibility. If the numerical difference between the average percentages of the asphalt residue in the 5-day settlement test is less than 3, and if the standard miscibility test shows no appreciable coagulation or visible separation in 2 hours, then the emulsified asphalt shall be considered as conforming to these specifications and shall be accepted.

c - The emulsified asphalt shall show no appreciable coagulation nor visible separation in two hours.

d - The emulsified asphalt shall show no appreciable separation of the asphaltic base from the water of the emulsion and shall coat the stone thoroughly.



TABLE 30-LBF-T  
(1956)

SPECIFICATION FOR RUBBERIZED RAPID-CURING CUTBACK ASPHALT

SPECIFICATION DESIGNATION	RC-3D	RC-4D	RC-5D	TESTS AASHTO METHOD
Flash Point, degree F. Furoil Viscosity at 140° F., sec at 180° F., sec	80+ 250-500	80+ 125-250	80+ 300-600	T-79 T-72 (1)
Distillation: Distillate (percent of total distillate to 370° F.) To 170° F. To 228° F. To 302° F. To 370° F.	25+ 55+ 83+ 100 67+	8+ 40+ 80+ 100 73+	--- 25+ 70+ 100 78+	
Residue from distillation to 370° F. (percentage volume by difference)				
Tests on Residue from distillation: Penetration at 77° F., 100 gms., 5 sec. Ductility at 77° F., 5 cm./min. Ductility at 39.2° F., 5 cm./min. Heptane-Xylene Equivalent Test - 35% Xylene	80-120 100+ 150+	80-120 100+ 150+	80-120 100+ 150+	T-49 T-51 T-51 (2) T-102
Separation Ratio Test	Neg 0.9-1.2	Neg. 0.9-1.2	Neg 0.9-1.2	(3)

Notes: 1 - A S T M D 1189-52T. Method of test for vacuum distillation of liquid and semi-solid asphaltic materials to obtain a residue of specified penetration (tentative) except as here in modified:

- a - Distillate receiver is immersed in ice and salt to condense all vapors.  
b - End point is 370° F. liquid temperature to protect rubber.

2 - A. A. S. H. O. T-51 except that the rate of pull is 5 cm./min. in lieu of the specified 1 cm./min.

3 - Separation Ratio Test: This test, which measures the stability of properties of rubberized asphalt cutbacks, is performed as follows: A quart sample of the rubberized cutback is placed in quart can, covered tightly and left to stand 24 hours in an oven at 200° F. Then the top portion and the bottom portion are withdrawn and the viscosities of both are measured. The ration of viscosity of the top to the bottom portion is the "Separation Ratio".

4 - General Requirements: The rubberized rapid-curing asphalt cutback shall consist of an intimate blend of vacuum-refined asphalt cement and unvulcanized rubber fluxed with a suitable solvent to meet the requirements of these specifications. The material shall be free from water.





## **SECTION 32**

### **BITUMINOUS PRIME OR TACK COAT**



**32.01 DESCRIPTION.** "Prime Coat" and "Tack Coat" shall consist of the application of specified bituminous material in accordance with these requirements and in conformity with the specifications and plans.

Prime coat shall be the application of bituminous material to a previously prepared aggregate or soil surface roadway, preparatory to placing surfacing materials.

Tack coat shall be the application of bituminous material to a previously constructed surface of any type, in preparation of placing bituminous surfacing materials.

**32.02 MATERIAL.** Bituminous material shall be the type and grade stipulated in the proposal and/or shown on the plans and shall meet the requirements of Section 30, "Bituminous Material."

**32.03 EQUIPMENT.** Shall conform to the requirements of Article 33.03, "Equipment," Section 33, as may be required for satisfactory accomplishment of the work.

**32.04 METHODS OF CONSTRUCTION.** Construction shall be performed according to the pertinent requirements of Article 33.04, Section 33, except as herein modified or supplemented.

**Modifications.** (a) Prime coat may be applied only during daylight, when the atmospheric temperature is not less than 50°F. and rising.

Tack coat may be applied only during daylight, when the atmospheric temperature is not less than 40°F. and rising.

Neither prime nor tack coat may be applied when the engineer determines that weather or roadway surface conditions are unfavorable to achievement of satisfactory results.

Amounts of bitumen to be applied and the rates of application shall be as directed by the engineer, in accordance with on the job determinations of the particular work requirements.

**Supplemental (b).** The contractor may, at his option and at his own expense, when permitted by the engineer, apply suitable material for "blotting" those areas where the bitumen has not "set-up" or dried sufficiently to prevent damage by traffic. In the case of a prime coat to be applied on an aggregate surface, the contractor may be permitted, as directed, to windrow a small amount of the aggregate surfacing to one side of the area to be primed. This windrowed material may subsequently be spread, for "blotting" purposes, over the freshly applied bitumen by blading, brooming or other approved methods. Being to the benefit of the contractor to facilitate his operations in this manner and prevent damage to the freshly primed surface by this method, such "blotting" operations, shall be at his sole expense.

If determined that the prime coat can be improved by compaction, the work, when directed, shall be accomplished with approved type rollers according to prescribed methods. Surplus aggregate, resulting from any method of "blotting"

freshly spread bitumen, shall be completely removed from the roadway surface in conformity with the hereinbefore prescribed methods, prior to the placing of any subsequent bituminous surfacing.

(c) The contractor, shall maintain the prime or tack coat surface intact until it has been covered with subsequent surfacing. Any breaks, holes, failures or deterioration of any kind or disintegration of the underlying course or courses of surfacing, suffered from any cause, shall be satisfactorily repaired. Costs of any such repairing, including any materials as necessitated, will not be paid for directly, but shall be considered necessary and incidental to the completed work and included of the bid items of the contract.

**32.05 PROTECTION OF TRAFFIC AND HIGHWAY STRUCTURES.** Shall be performed in accordance with the provisions of Section 33, "Bituminous Surface Treatment."

**32.06 METHOD OF MEASUREMENT.** Bituminous material will be measured in accordance with the provisions of Section 30, "Bituminous Material."

Rolling, watering and/or other contract items will be measured in accordance with the requirements of the respective Sections 14 and 15 and other pertinent sections.

When the proposal form specifies that bituminous material shall be furnished to the project, but not applied to the roadway, then measurement shall be made in the vehicle, delivered on the site, in accordance with the provisions of Article 30.04.

**32.07 BASIS OF PAYMENT.** Bituminous material will be paid for at the contract unit bid price in accordance with the provisions of Section 30, "Bituminous Material."

Rolling, watering and/or other items will be paid for at the contract unit bid prices in accordance with the requirements of the respective specifications, Sections 14 and 15 and other pertinent sections.

When the proposal form specifies that bituminous material shall be furnished to the project, but not applied to the roadway, then payment shall be made for the measured quantity, delivered on the site, in accord with the provisions of Article 30.05.

Item Description	Unit	Item No.	Unit	Item No.
Application of Prime Coat	Gallon	3210	Ton	3230
Application of Tack Coat	Gallon	3220	Ton	3240
Furnish Prime Coat Material	Gallon	3215	Ton	3235
Furnish Tack Coat Material	Gallon	3225	Ton	3245







## SECTION 33

# BITUMINOUS SURFACE TREATMENT



**33.01 DESCRIPTION.** "Bituminous Surface Treatment" shall consist of one or more applications of bituminous material on a properly prepared roadway surface with each application, unless specified otherwise, being covered with aggregate surfacing material in conformity with these requirements and the specifications and plans.

**33.02 MATERIAL.** (a) Bituminous material shall be the type and grade stipulated in the proposal and/or shown on the plans and shall meet the requirements of Section 30, "Bituminous Materials."

(b) Aggregate for covering the bituminous material shall be the type and grading stipulated in the proposal and/or shown on the plans.

(c) Quantities of bitumen and aggregate will be as specified in the plans or as directed by the engineer.

**33.03 EQUIPMENT.** The contractor shall maintain on the project, throughout the course of the work, the following listed previously approved equipment:

(a) One fully operable bituminous material pressure distributor of at least one-thousand (1,000) gallon capacity meeting the following requirements:

The tank shall be insulated and equipped with internal steam coils or equivalent heating facilities. The distributor shall be fully equipped with a spray bar of the full circulating type at least nine (9) feet in length, so constructed as to permit adjustment for length in increments of one (1) foot for any lengths up to sixteen (16) feet, to allow vertical adjustment of all nozzles to the desired height above the road surface and conforming to the roadway crown and to permit lateral shifting of the entire spray bar during operation. The spray bars and nozzles shall be constructed so as to prevent clogging of the nozzles during intermittent operation and to provide positive and immediate cut-off when distribution of the bitumen ceases, thus preventing dripping of the bitumen from the bar. The nozzles attached to the bar shall be either of the conical or flat-slotted type. The valves which control the flow from nozzles shall be of positive acting design so as to provide a uniform unbroken spread of bitumen on the surface.

The distributor shall be equipped with devices and charts to provide for accurate rapid determination and control of the amount of bitumen being applied per square yard of surface and with a tachometer of the fifth-wheel type indicating speeds in feet per minute. The pressure pump shall be powered independently from the propelling motor of the vehicle. The distributor shall be equipped with a pressure pump, pressure gauge, thermometer well, thermometer and an accurately calibrated fluid content gauge. It shall be equipped with pneumatic tires of sufficient number to meet the legal road requirements of the State and shall be adequately powered to perform the necessary work without assistance

from other units. In addition, the distributor spray bar shall be so arranged that its height above the roadway, as set, shall remain constant throughout the application of bituminous material to the surface.

**(b) Heating Equipment.** For heating bituminous material to the required application temperature.

**(c) Rollers.** Rolling equipment shall meet the requirements of Section 14, Article 14.02, Paragraph (a) 1 and Paragraph (c).

**(d) Aggregate Spreader.** One self-propelled or truck mounted aggregate spreader of the force feed type with rate of application control independent of spreader motive power.

**(e) Cleaning Equipment.** For cleaning roadway surface, such as efficient power brooms, blowers and/or suitable hand brooms.

**(f) Water Facilities.** For wetting cover material in hauling units immediately prior to spreading it on the bituminized roadway surface.

**(g) Watering Equipment.** Shall conform to the requirements of Section 15, Article 15.02.

**(h) Scales.** Shall meet the requirements of Section 20, Article 20.03, Paragraph (e).

**33.04 CONSTRUCTION METHODS. (a) Existing Surface Preparation.** Unless surface preparation is included in surfacing items of the contract, the required work shall be performed in accordance with the pertinent provisions of Subsection 16.10, Article 16.12, except as may be herein modified or supplemented.

Particular attention is directed to the fact that surface stability and excellence of the riding quality of the completed bituminous surface treatment is completely dependent on the careful preparation and smoothness obtained of the aggregate surface to which the treatment is applied. In any case, the entire course of aggregate composing the surface to which the bituminous surface treatment is to be applied shall not be laid down and prepared until such time as weather and other pertinent conditions will permit the application of bitumen.

It shall be the intent of this specification that the contractor shall not place any top course material upon the roadway until such a time that he can complete the paving operations without interruption. If the paving operation cannot be completed, the top course material may be stockpiled at his option.

In the event that the contractor elects to crush out the top course at such a time that the paving cannot be completed and elects to stockpile the material for later use, the cost of stockpiling, loss of material through stockpiling, loading, and incidentals involved in placing the top course surfacing from the stockpile shall be done at the sole expense of the contractor.

(b) **Sweeping.** Immediately in advance of the first application of bituminous material, the roadway surface shall be swept clean of all dust, dirt or foreign matter, by means of a power broom, blower and/or hand brooming as required for satisfactory cleaning of the surface. When directed, a light uniform application of water with compaction, if required, shall be applied to the roadway surface with the specified type equipment, just prior to application of the bitumen. The top two (2) inches of the course shall not contain more than three (3) percent of moisture by weight of aggregate. If determined necessary by the engineer, as a measure of surface consolidation, a prime coat of bituminous material shall be applied, at the rate directed, prior to the initial application of bituminous surface treatment.

(c) **Application of Bitumen.** Immediately following the cleaning and/or wetting of the roadway surface, the first application of bitumen shall be uniformly applied at the temperature and at the rate per square yard, as directed by the engineer, by means of a pressure distributor of the type described hereinbefore.

Extreme care shall be taken in application of the bitumen to secure uniform surface cover and true lines. If directed by the engineer, and the bitumen stipulated for the first application is of a light viscosity type such as a cutback grade of 0, 1 or 2, the first application may be applied when the atmospheric temperature is 50°F. and rising. For the second application or when the bitumen is of a heavy viscosity type such as cutback grades 3, 4 or 5, emulsified asphalt or penetration asphalt, the application shall be made only when the atmospheric temperature is 65°F. and rising. In case of either type of bituminous material, weather conditions shall be such that the bitumen will not become chilled before the cover material can be spread and rolled. Work shall not be started without consent of the engineer and shall be promptly terminated in the event of rain, high wind velocity or the occurrence of unfavorable road or weather conditions.

(d) **Application of Cover Material.** When directed by the engineer, the first application of bitumen may be allowed to remain uncovered for a period of time up to sixty (60) minutes as directed by the engineer. Spreading of a minimum amount of cover material shall be made on the freshly spread bitumen, when the engineer determines that the maximum depth of downward penetration has been attained and that the consistency of bitumen has become such that the best "keying" results will be obtained.

In the case of heavy viscosity types of bituminous materials, the contractor shall not proceed with the application of bitumen until a supply of aggregate sufficient to cover the entire application is immediately available for covering the bitumen in less than five (5) minutes.

The bitumen application shall be covered with the specified cover material, at the rate per square yard as directed by the engineer, spread uniformly over the bitumen with a



self-propelled or truck mounted mechanical spreader of the type hereinbefore specified. Aggregate spreaders that fail to make a uniform and satisfactory distribution of material must be promptly removed from further use. Special care must be exercised in the spreading of cover material in order that uniformity of cover and longitudinal lines will be secured. Operation of the spreader motive equipment shall, at all times, be assigned to the same experienced operator.

When called for in the proposal and/or if directed by the engineer, the cover material for any course may be wetted by watering after weighing prior to spreading it upon the bituminous material.

Brooming by mechanical or hand methods, if directed by the engineer, shall be employed to insure uniform distribution of the cover material. When brooming is resorted to, particular caution must be exercised to avoid displacement or loosening of particles of cover material from the bitumen.

Bituminous material applications shall not be made to such a distance that uncovered bitumen in "meet line" areas will become chilled to such extent during the time interval that it will not successfully "key" the maximum amount of cover aggregate. Bitumen must be applied in such manner and with such care that transverse and longitudinal joints of "meets" of successive applications will not result in ridges or depressions and will be smooth, consistent with the adjacent surface of the completed treatment.

Longitudinal laps (meet lines) may be from six (6) to ten (10) inches in width, but there shall be no overlap at the end junction of applications. In order to prevent lapping at transverse junctions, the distributor shall be promptly shut off, and, if necessary to prevent dripping, a drip pan shall be inserted under the nozzles when the application begins to thin. Before continuing application of the bitumen, building paper or metal sheets shall be spread over the treated surface for sufficient distance back from the joint on the cover aggregate so that the sprayers are operating at full force, and the distributor has attained the predetermined speed upon reaching the surface to which application is to be made. Any paper used for covering joints shall be removed and destroyed.

All transverse joints shall be covered with aggregate and shall be broomed back before the next longitudinal application of bitumen is made. Trucks hauling covering material to the spreader units, or traffic, shall not be permitted at any time, or under any circumstances, to cross over or drive on any uncovered bituminous material including "meet" lines. When operating over freshly spread cover material, the speed of vehicular traffic shall be so regulated that loosening and displacement of cover material will not occur. Trucks failing to observe these requirements shall be promptly dismissed from the work. When it is necessary to cover "meet" lines to permit trucks or traffic to cross over, such cover aggregate shall be neatly broomed back exposing the full width of the meet line before the abutting application of bitumen is made.

There shall only be permitted a minimum number of "meet" lines, compatible with the width of the roadway surface. Permission may be granted by the engineer to make full road surface width application of bitumen and cover aggregate, to be performed in a single continuous operation so coordinated that the movement of public traffic will not suffer greater inconvenience than that resulting from strip or half roadway width methods.

**(e) Rolling.** Rolling of cover aggregate shall commence immediately upon spreading and shall be prosecuted with such diligence that all freshly spread material shall be promptly rolled without delays of any nature. Rolling shall be accomplished with rollers of the types described hereinbefore. It is intended that the initial rolling shall be accomplished with the self-propelled tandem steel-wheeled roller, operating as close to the mechanical spreader as conditions will permit. Rolling shall be continued, at the direction of the engineer, in such manner and for such length of time that the initial rolling shall consist of at least one (1) complete coverage by the steel-wheeled roller followed by a minimum of four (4) completed coverages by pneumatic rubber-tired rollers. The minimum of four (4) complete coverages by rubber-tired rolling shall be completed within four (4) hours after the application of cover material. If additional rollers are needed to comply with the time and coverage requirement of this specification, the use of pull or towed type rubber-tired rollers may be permitted by the engineer. The speed and reversal of direction of movement of all rollers shall be so regulated as to avoid displacement or loosening of cover material.

**(f) Curing Time After First Application.** After rolling is completed and the surface is smooth and free of ruts and ridges, the surface may be opened to traffic subject to traffic control requirements as hereinafter specified.

The surface shall be allowed to cure for a minimum period of five (5) days and longer, if necessary, as determined by the engineer, for the surface to become satisfactorily cured for placement of the succeeding course. The second application shall not be applied before May 15 nor later than September 15 without written approval by the Engineer. Any breaks or holes that develop in the treated surface shall be substantially repaired immediately with bituminous treatment methods or a premixed bituminous aggregate. Any areas showing excessive bitumen shall be covered with aggregate and rolled. Cost of any such repairing required shall not be paid for directly but shall be included in the other bid items in the contract.

**(g) Cleaning.** After the first application of bitumen and cover material has satisfactorily cured and set, as directed by the engineer, and any repairs required have been properly made, all excess cover material, dirt, dust and foreign materials shall be removed from the surface by sweeping with power brooms, hand brooms, blowers and/or water washing to produce a positively clean surface. Construction

of the succeeding course may then proceed on the clean surface using a repetition of the construction methods specified for the preceding course.

**(h) Completion.** Upon completion of this course, if it is the final course, the surface shall be opened to traffic for a period of three (3) days, with the period of specified traffic control in effect. During this period, the surface shall be maintained by brooming and/or rolling, as directed by the engineer. Any holes or breaks that may occur shall be satisfactorily repaired by methods hereinbefore specified. Any areas showing excess bitumen shall be covered with aggregate and rolled. Any irregularities influencing the stability and riding quality of the surface shall be corrected in a satisfactory manner. Cost of any such repairing or corrections shall not be paid for directly but shall be included in the other bid items in the contract.

**33.05 PROTECTION OF TRAFFIC AND HIGHWAY STRUCTURES.** **(a) Traffic Protection.** Shall be performed, unless otherwise stipulated, in accord with the provisions of Schedule 2, Article 16.31, Subsection 16.30, "Traffic Provisions."

**(b) Structure Protection.** The contractor shall provide whatever protective covering may be necessary to protect exposed portions of bridges, culverts, curbs, gutters, guard fences, road signs and other roadside structures from becoming splashed or sprayed with bitumen and he shall remove from such structures, any bitumen, dirt or other undesirable matter that may come upon them by reason of his operations. Compensation for this protection shall be included in the unit price bid for the application of bituminous material.

The contractor shall recondition, at his expense, any damage done to the highway or structures due to the operation of his equipment or caused by traffic being forced away from the usual line of travel.

**33.06 METHOD OF MEASUREMENT.** **(a)** Bituminous material used in the completed and accepted work will be measured by the U. S. gallon, or by the ton, as stipulated in the proposal and in accord with Section 30, "Bituminous Materials."

**(b)** Cover material used in the completed and accepted work will be measured by the ton on scales furnished by the contractor, or the cubic yard measured in the vehicle at point of delivery on the roadway, as stipulated in the proposal and in accord with Section 20, "Aggregate Surfacing—General Conditions."

**(c)** Rolling will be measured as provided for in Section 14, "Rolling."

**(d)** Watering will be measured by the unit stipulated in the proposal and in accord with Section 15, "Watering."

**(e)** Other items specified in the contract will be measured as stipulated in the proposal.

**(f)** Traffic protection will not be measured unless specified otherwise.

**33.07 BASIS OF PAYMENT.** (a) Application of any bituminous material, cover material, rolling, watering and/or any other items specified in the contract, will be paid for at the contract unit price bid for the unit specified in the method of measurement and/or proposal, which prices and payment shall each be full compensation for furnishing all material, unless otherwise indicated in the proposal; for delivering, preparing, handling and placing all materials and for all other charges; for maintenance of the completed surface until acceptance and for all manipulations, labor, tools, equipment and all incidentals necessary to complete the work.

(b) On projects in which the construction of the base and bituminous surface treatment is included in one contract, "Existing Surface Preparation" will not be paid for as a separate item, but shall be considered as incidental to the base construction.

(c) On projects in which bituminous surface treatment is contained in a separate contract, "Existing Surface Preparation" shall be performed in accordance with the requirements of Subsection 16.10, "Existing Surface Preparation." In this case, if and unless specified in the proposal, the work required of existing surface preparation will not be paid for directly, but shall be considered incidental to the payment for and performance of the other items in the contract.

For Payment of Bituminous Material—See Section 30.

For Payment of Cover Material—See Section 27.

For Payment of Rolling—See Section 14.

For Payment of Watering—See Section 15.

For Payment of Traffic Protection—See Subsection 16.30, if a pay item.

Unless otherwise provided, traffic protection will not be paid for directly, but shall be considered incidental and necessary to the performance of, and included in the payment for the other items of the contract and shall include all labor, equipment, tools, lights, signs and all incidentals necessary to complete the work.

Item Description	Unit	Item No.	Unit	Item No.
Application of $\frac{3}{4}$ " Aggregate— Cubic Yd.		3311	Ton	3312
Application of $\frac{5}{8}$ " Aggregate— Cubic Yd.		3321	Ton	3322
Application of $\frac{1}{2}$ " Aggregate— Cubic Yd.		3331	Ton	3332
Application of $\frac{3}{8}$ " Aggregate— Cubic Yd.		3341	Ton	3342
Application of Sand Aggregate— Cubic Yd.		3351	Ton	3352





**SECTION 34**  
**BITUMINOUS SURFACING**  
**ROAD MIX**





**34.01 DESCRIPTION.** "Road Mix Bituminous Surfacing" shall consist of aggregate and bituminous material, constructed on the roadway by mechanically mixing and processing these materials and spreading and compacting the resulting completed mixture in accordance with these requirements and the specifications and plans.

**34.02 MATERIAL.** (a) Bituminous material shall be the type and grade stipulated in the proposal and/or shown on the plans and shall meet the requirements of Section 30, "Bituminous Material."

(b) Aggregate to be bituminized shall be either all new aggregate, of the type and grading stipulated, or a blend of new aggregate and material obtained from the existing roadway surface or entirely material obtained from the existing surface, as may be required by the proposal and/or plans.

**34.03 ORGANIZATION.** On projects five (5) miles or more in length, the organization shall be of extent capable of completing at least one-half ( $\frac{1}{2}$ ) mile of continuous road mixed surface each day. On projects less than five (5) miles in length, the organization shall be sufficient to accomplish completion of the road mix construction in ten (10) working days or less. When the project is used by traffic, the rates of progress on the various phases shall be such that only a minimum length of work will be under construction at one time.

Sufficient mixing units shall be maintained on the project to insure compliance with the required rate of construction progress.

**34.04 EQUIPMENT.** (a) **Bituminous Distributor.** The contractor will be required, regardless of project length or type of mixing equipment being used, to maintain on the project, a bituminous distributor meeting the requirements of Article 33.03, Equipment, Section 33.

(b) **Motor Graders.** Shall meet the requirements of Article 20.03, Equipment, Section 20, "Aggregate Surfacing—General Conditions."

(c) **Road Plants and Machines.** All travelling road mixing plants and/or machines shall meet with the approval of the engineer. Such plants or machines must be equipped with positive measuring devices, to be set by the engineer and not varied except by his order, for the accurate volume or weight measuring and proportioning of the bitumen and aggregate. Aggregate pickup devices shall be capable of taking up all loose material, leaving the base surface clear and undamaged. Mixing machines which do not pick up the aggregate also may be used, if approved. Auxiliary mixing machines which mix the material on the roadway, but are not equipped with a bitumen proportioning device, also may be used. If the windrow is too large for the machine to handle properly, it may be divided into two or more windrows of workable and equal size.

Use of any travelling plant or mixing machine anticipates the auxiliary use of blade graders to properly aerate the materials, complete the mixing operation and perform "lay-down" of the mixture. Irrespective of the type of road mixing plant or machine used, the contractor shall maintain on the project not less than two motor graders of the type specified.

Any motive equipment, regardless of type or kind, shall be adequately powered to prevent damage, to the roadway surface upon which it is working, from slippage or spinning of the traction contact areas.

**(d) Stationary Plants.** If approved by the engineer, the mixing of new aggregate and bituminous material in a stationary plant may be permitted. In this case mixing and aeration of the materials, if not completed in the plant, shall be completed on the roadway as required under these specifications. The contractor may be permitted to accomplish mixing, spreading and compacting of the materials as specified in Section 35. In the event of use of stationary plant methods, no compensation other than price adjustment for change of type and/or grade of bituminous material will be allowed.

**(e) Rollers.** Rollers shall be the types specified in Paragraph (a), 2 and 3, and Paragraph (c), Article 14.02, Section 14, "Rolling."

**34.04 CONSTRUCTION METHODS. (a) Limitations and Conditions. (1) Weather, Seasonal and Time.** The operations of bitumen application, machine or blade mixing, aeration, spreading or compacting shall not be done prior to May 15th, nor shall it be continued later than September 15th. Such operations shall not be done when the temperature, weather and road conditions are such that the specified results cannot be obtained. No work shall be prosecuted except in daylight.

**(2) Scope of Operations.** The contractor shall not open up more than two (2) miles at one operation and at no time shall there be more than three (3) miles under process of actual bituminous construction.

**(3) Stockpiling.** The contractor shall not place any aggregate, either new or that obtained from the existing surface, upon the roadway until such time that he can complete the mixing operation without interruption. If this operation cannot be completed the material may be stockpiled, at his option. If the contractor elects to produce the new aggregate at such time that the mixing operation cannot be completed, the aggregate may be stockpiled for later use and the costs and all incidentals involved in the stockpile operation shall be at complete expense of the contractor.

**(4) Moisture Content.** Should the moisture content of the aggregate exceed three (3) percent by weight, it shall be dried before applying the bitumen. If approved, the contractor may use a previously approved commercial anti-stripping additive in the bitumen, at his own expense, to assist mixing, when the mixture is not in excess of five (5) percent.

In event of rain during the application of bitumen, or the mixing operation, the material shall be windrowed promptly. If rain occurs and the treated or untreated material is windrowed on the roadway, the contractor shall immediately drain any water puddles. The treated material and the base shall be allowed to dry before the resumption of any work, except such mixing as will facilitate drying. In no case shall the bituminized material be "laid" while either the material or the roadbed is damp or wet. The engineer shall be sole judge as to when the roadbed has dried sufficiently for work to be resumed. However, in no case shall the moisture content in the upper six (6) inches of the base be more than three and one-half (3½) percent when the mixture is "laid."

**(b) Protection of Traffic and Highway Structure. (1) Protection of Traffic.** This shall be performed in accordance with the provisions of Schedule 1, Article 16.31, Subsection 16.30, "Traffic Provisions."

**(2) Protection of Highway Structures.** Shall conform to the provisions specified in Article 33.05, Section 33, "Bituminous Surface Treatment."

Work will be considered in progress whenever the contractor's equipment is on the roadway, regardless of whether it is in motion or not, or when material has not been windrowed in a safe manner. At night, or at other times when active work is not in progress, all material shall be left in a uniform windrow, placed as directed, in order to leave the roadway in the "safest possible condition" for use of the "Public." At night the treated or untreated gravel windrow shall be lighted with lanterns or suitable flares which shall be spaced at such intervals as to clearly indicate the position of the windrow and at such other intervals as may be directed. No other equipment, except travelling road mixing plants, may be left on the roadway when active work operations are not in progress and such plants shall be clearly marked with the use of danger signs, signals and flares.

**(c) Prime or Tack Coat.** Application of prime coat or tack coat, as the case may be, when designated on the plans and/or proposal, or directed, shall be accomplished in accordance with requirements of Section 32, "Prime or Tack Coat."

**(d) Aggregate. (1)** Where aggregate is to be obtained, in whole or in part, from the existing roadway the surface shall be scarified to a depth which will produce the quantity of loose material required for the compacted thickness of the bituminous surfacing shown on the plans. Extreme care shall be exercised to avoid loosening of the base surface or scarifying below the depth necessary to produce the required amount of material. All clods shall be broken and the loose material bladed into a windrow.

The base surface shall then be shaped and compacted to conform to the typical section. When it is specified that new material is to be blended with material obtained from the existing roadway, the amount of new material to be added

shall be designated on the plans or by the engineer. Blending of the old and new material shall be complete, in all respects, before the application of any bitumen.

(2) When new aggregate is to be used the existing roadway surface shall be shaped and compacted to the typical section shown on the plans and the prime coat applied, when directed, prior to placing the new aggregate. The new aggregate for the bituminous surface course shall be placed in a uniform windrow on one side of the roadway.

After the material, either new material or material from the existing roadway, is windrowed at one side of the roadway the windrow shall be equalized in size throughout its entire length by means of graders or mechanical equalizing devices. If necessary, in order to secure uniformity of the windrow, material shall be hauled from sections where there is an excess to those deficient sections.

(e) **Bitumen Application.** Bituminous material shall be applied at the rates, temperature, and in the manner directed by the engineer. All aggregate shall have received uniform amounts of bitumen when the application process is completed. When applied with a distributor, or mixing machines equipped with applicators, the windrowed aggregate shall be spread by laying in successive layers not less than eight (8) feet wide with each preceding layer being applied, full width, with a uniform amount of bitumen. Not less than three (3) layers of aggregate and application of bitumen shall be made.

(f) **Processing.** After the last application of bitumen and partial mixing the entire mass of surfacing material shall be moved by blade graders into a windrow. The windrow shall then be moved from side to side of the roadway with a revolving motion until all particles of aggregate are coated with bitumen and the whole mass has a uniform color and bitumen content and has been satisfactorily aerated for spreading and compacting the material.

At least eight (8) moves of the material across the roadway will be required, under the most favorable conditions of air temperature, material, grading, efficiency of equipment and skillful workmanship. A move shall be understood to consist of the movement of the entire mass from one edge of the proposed roadway section to the other. Under conditions less favorable for effective mixing, as many more moves will be required as is necessary to produce the desired uniformity of mixture.

The moving or mixing shall be carried on in such a manner that there will be neither segregation of material nor loss of mineral filler from the mixture.

No portion of mixed material shall be spread or allowed to remain on the roadway until the entire mass of material is thoroughly mixed. It then shall be spread and placed in one operation unless, in the judgment of the engineer, it may be expedient to permit the dropping of a small portion of the mixture to serve as a mixing floor.



Any equipment, other than that specified, may be used, with approval of the engineer, if it will produce a completed mixture equal to that which would be produced by the means specified. The engineer reserves the right to order the use of any equipment discontinued which, in his opinion, may damage, to any extent, a section or portion of the roadway or which may fail to produce a satisfactory mixture and completed results.

After the mixing operation is completed the mixture shall be examined to determine whether the proper proportion of bitumen has been used. If the proportion of bitumen is excessive, additional uncoated material shall be hauled onto the moist section, at the option of the engineer, and shall be thoroughly mixed with the original mass by blading. If more bitumen is required a portion of the mixed material shall be spread upon one side of the roadway, the required additional bitumen distributed thereon, and the mixing resumed until uniformity of mixture is secured.

Any oversize aggregate which may enter the mixture, regardless of its origin, shall be forked from the roadway, at the contractor's expense, during the progress of the mixing. Oversize material, or any rock which will not pass the maximum sieve of the specified grading, shall be considered to be foreign material.

Any costs necessitated through the required addition of bituminous material or untreated surfacing material to correct the uniformity of the mix, or any additional material or work required due to the entrance of moisture or for any other reason prior to the completion of the final rolling of the surface, or for widening of the bituminous surfacing course over intermittent sections for turnouts, traffic lanes, etc., not shown on the plans, shall be considered incidental to the unit price of bid items and no additional compensation for such work will be allowed.

**(g) Spreading and Compacting.** After a satisfactory mixture has been secured, it shall be spread to the specified thickness shown on the plans by a pneumatic-tired motor grader of the prescribed type. It shall be compacted in accordance with the provisions of Paragraph (c), Article 14.03, Section 14, "Rolling."

Any defects, such as ravelling, low centers, lack of uniformity or other imperfections caused by faulty workmanship shall be corrected to the satisfaction of the engineer and new work shall not be opened up until such defects have been remedied.

However, after the bitumen has been mixed with the aggregate and has been spread and finally compacted in compliance with these specifications, then any additional materials and work, where tear-up and reprocessing are required, will be paid for on a force account basis. (See Article 09.04, Section 9).

This provision shall not cover failures which result from the effects of rain during the spreading or rolling operation or failures which may be patched or repaired by hand meth-



ods, but shall apply to those sections of the surface which necessitates tearing up with motorized equipment, adding bituminous material or aggregate, remixing, relaying and compacting.

The finished surface shall be free of ruts, defects and depressions exceeding one-fourth ( $\frac{1}{4}$ ) inch, as measured with a ten (10) foot straightedge, paralleling the center of the roadway and shall have an entirely smooth riding quality. Any variations shall be corrected by scarifying and relaying the mixture at the contractor's expense.

**(h) Seal Coat.** Seal coat, when specified, shall be accomplished according to the requirements of Section 36, "Bituminous Seal Coat."

**34.06 METHOD OF MEASUREMENT.** (a) Bituminous material will be measured in accordance with the requirements of Section 30, "Bituminous Material."

**(b)** Any new or additional aggregate required for the bituminous surfacing course and/or the shoulders will be measured in accordance with the requirements of Section 20, "Aggregate Surfacing—General Conditions."

**(c)** Processing of all bituminous surfacing materials in the completed and accepted work will be measured by the mile along the centerline of the roadway, and/or by the square yard, as stipulated in the proposal.

**(d)** Rolling, watering and/or other contract items will be measured in accordance with the requirements of the respective specifications.

**34.07 BASIS OF PAYMENT.** (a) Bituminous material will be paid for at the contract unit bid price in accordance with the requirements of Section 30.

**(b)** Any new or additional surfacing aggregate required to construct the bituminous surface course or the shoulders will be paid for at the contract unit bid price in accordance with the respective requirements of Section 20.

**(c)** Aggregate obtained from the roadway will not be paid for directly but shall be considered incidental and necessary to the performance of and payment for the other items of the contract, and shall include all labor, equipment, tools and all incidentals necessary to complete the work.

**(d)** Processing of the bituminous surfacing materials will be paid for at the contract unit bid price per mile or per square yard, which price and payment shall constitute full compensation for preparing subgrade or base, unless otherwise specified, for furnishing, handling, mixing, manipulating, shaping and placing all materials, for all labor, equipment, tools and incidentals necessary to complete the work.

**(e)** Rolling, watering and/or other items will be paid for at the contract unit bid prices in accordance with the requirements of the respective specifications.

Item numbers for processing bituminous mat are as follows:

Item No.	Item Description	Unit
3402	24 ft. Bituminous Mat—1.5"	Mile
3403	24 ft. Bituminous Mat—2.0"	Mile
3404	24 ft. Bituminous Mat—2.5"	Mile
3405	26 ft. Bituminous Mat—1.5"	Mile
3406	26 ft. Bituminous Mat—2.0"	Mile
3407	26 ft. Bituminous Mat—2.5"	Mile
3408	28 ft. Bituminous Mat—1.5"	Mile
3409	28 ft. Bituminous Mat—2.0"	Mile
3410	28 ft. Bituminous Mat—2.5"	Mile
3450	Bituminous Mat—1.5"	Square Yd.
3451	Bituminous Mat—2.0"	Square Yd.
3452	Bituminous Mat—2.5"	Square Yd.



**SECTION 35**  
**BITUMINOUS SURFACING**  
**PLANT MIX**



**35.01 DESCRIPTION.** "Plant Mix Bituminous Surfacing" shall consist of aggregate surfacing and bituminous material mixed at a central plant in accordance with these requirements and placed in one or more courses on a prepared or existing roadway surface in accordance with the specifications and plans.

The compacted thickness of each course shown on the plans shall be determined according to the formula in Paragraph (g), Compaction, Article 35.10, of this specification.

**35.02 TYPES.** The types of "Plant Mix Bituminous Surfacing" shall be designated as Type I (no-bin separation); Type II (2-bin separation) or Type III (3 or more bin separation).

**35.03 MATERIALS. (a) Aggregate.** Unless otherwise indicated in the proposal, the aggregate for Type I and Type II Plant Mix Surfacing shall conform to all the requirements for "Type 'A' Crushed Top Surfacing," the particular grading of which will be stipulated in the proposal. The composite grading of the specified aggregate produced during any one 8-hour run shall be held to such uniformity that percentages passing the Nos. 4, 10 and 200 sieves for any one sample shall not vary from the average of all samples for the "run" by more than the following tolerances:

Material Passing	Percent
No. 4 Sieve	5
No. 10 Sieve	5
No. 200 Sieve	2

The engineer may, when necessary to obtain a desired and uniform mixture, fix the maximum and/or minimum percent of aggregate passing the No. 4 sieve within the specified limits and the contractor will not be allowed any compensation for costs incurred in the rejection of fines or adjustments required in conforming to such established limits.

Filler shall conform with all requirements of Section 26, "Binder or Filler."

**(b) Bituminous Material.** The bituminous material shall be the type and grade stipulated in the proposal and shall conform to the requirements of Section 30, "Bituminous Materials."

The percentage of bitumen by weight, to be added to the aggregate shall be, generally, between three and one-half ( $3\frac{1}{2}$ ) and seven (7) percent of the weight of the dry aggregate. The exact percentage of bitumen in the mix shall be fixed by the engineer, based upon preliminary laboratory tests, sieve analysis and grading and character of the aggregate.

gate furnished within the specification limits and the contractor will not be allowed any claim for payment for the rejection of any batch or load of resultant mixture which contains an excess or deficient amount of bitumen varying more than three-tenths (0.3) of one (1.0) percent from the exact percentage as fixed by the engineer.

**35.04 REQUIREMENTS FOR ALL MIXING PLANTS.** (a) Mixing plants shall be either the weight batching type or the continuous flow mixing type. Both types of plants shall be equipped with satisfactory conveyors, power units, aggregate handling equipment, aggregate screens and bins and shall be so coordinated and operated as to produce a mixture consistent within the job mix tolerance specified.

Batch type plants shall have a minimum batch production capacity of two-thousand (2,000) pounds and continuous flow plants shall have a minimum production capacity of sixty (60) tons an hour.

Suitable to certain job conditions, these capacity requirements may be modified if so stipulated in the proposal.

Mixing plants that will not continuously produce a mixture meeting requirements as specified, will be condemned and shall be removed from the job.

(b) **Storage and Heating Equipment.** (Bitumen) tanks (or kettles) for storage of bitumen shall have a total capacity sufficient for not less than ten (10) hours run of the mixing plant and shall be capable of heating the bitumen, under effective and positive control at all times, to temperature requirements of Section 30, "Bituminous Materials."

The heating system shall provide uniform heating of the entire contents of tanks. Heating shall be accomplished by steam coils, electricity or other approved means so that no flame shall come in contact with the heating tanks. The circulating system for bitumen shall be of adequate size to insure proper and continuous circulation during the entire operating period and shall be a closed system, with its own pump or pumps, and with no inlet or outlet pipe or drain into which fuel oil or similar material can be introduced. Storage tanks shall have a positive means of measuring the quantity therein by gauge, calibrated rod or float.

An armored thermometer of adequate range in temperature reading shall be fixed in the bitumen feed line at a suitable location near the discharge valve at the mixing unit.

(c) **Feeder for Dryer.** Plants shall be provided with accurate, mechanical means for uniformly feeding the mineral aggregate into the dryer so that a uniform product and a uniform temperature may be secured.

(d) **Dryer.** Plants shall include a dryer or dryers that will continuously agitate the aggregate during the heating and drying process; shall be capable of drying and heating all aggregate to the temperature specified without burning or overheating any portion in supplying the mixing unit con-



tinuously at its operating capacity. The dryer shall be equipped with an approved dial scale, mercury actuated thermometer, an electric pyrometer or other approved thermometric instrument so placed at the discharge chute of the dryer as to register automatically or indicate the temperature of the heating aggregate.

(e) **Screens.** Plant screens, capable of screening all aggregate to the specified sizes and proportions and having normal capacity in excess of the full capacity of the mixing unit, shall be provided.

(f) **Bins.** The plant shall be equipped with storage bins, protecting the aggregate from the weather, of sufficient size to insure adequate storage of appropriate fractions of the aggregate and the bins shall be so constructed as to prevent overflow of one size into a bin used for another size. Separate dry storage shall be provided for mineral filler when used. Each bin shall be provided with its individual outlet gate, designed and constructed so that when closed there will be no leakage and the gates will cut off quickly and completely.

(g) **Bitumen Control Units.** Satisfactory means, either by weighing, metering or volumetric measurements, shall be provided to obtain the proper amount of bitumen in the mix within the tolerances specified for the job mix. Suitable means shall be provided, either by steam jacketing or other insulating, for maintaining the specified temperature of the bitumen in the pipe lines, meters, weigh buckets, spray bars, and other containers or flow lines.

(h) **Dust Collectors.** If plants are located in any vicinity where dust may be objectionable to adjacent property owners, or when dust interferes with the efficient operation of the plant, proper housings, mixer covers or dust collecting systems shall be installed. They shall be constructed and operated to dispose of or return uniformly, all or any part of the material collected to the hot elevators as directed by the engineer.

(i) **Scales for Hauling Units.** Shall meet the pertinent requirements of Section 20, "Aggregate Surfacing—General Conditions."

(j) **Safety and Access Requirements.** The engineer shall, at all times, have free and easy access to any part of the plant. Adequate and safe stairways to the mixer platform and guarded ladders to other plant units shall be placed at all points required for accessibility to all plant operations. All gears, pulleys, chains, sprockets and other dangerous moving parts shall be thoroughly guarded and protected. Ample and unobstructed space shall be provided on the mixing platform. A clear and unobstructed passage shall be maintained at all times around the truck loading space. This space shall be kept free of drippings from the mixing platform.

(k) **Field Laboratory.** Shall meet the requirements of Section 20.

**35.05 BATCHING PLANT. (Special Requirements) (a) Plant Scales.** Scales for any weigh box or hopper may be either the beam or springless dial type and shall be of a standard make and design, accurate to five-tenths (0.5) of one (1) percent.

When scales are of the beam type there shall be a separate beam with tell-tale indicator for each size aggregate and a tare beam for balancing the hopper. The tell-tale indicator shall start to function when the load being applied is within one-hundred (100) pounds of that desired.

Dial scales shall be springless, of standard make, designed, constructed and installed so that they will be maintained free from vibration, and of such size that the numerals on the dial may be read at a distance of at least ten (10) feet. The dials shall be of the compounding type having full complements of index points. Pointers so placed as to give excessive parallax errors shall not be used. The scales shall be substantially constructed and, if not capable of maintaining positive adjustment, shall be replaced when so ordered. All dials shall be located as to be plainly visible to the operator at all times.

All weighing equipment shall be approved by the engineer and shall be capable of easy adjustment of any working part and shall be sealed prior to initial use, and as often thereafter as the engineer may consider necessary to insure accuracy.

**(b) Weigh Box or Hopper.** Bin storage shall be provided with tight cutoff gates so that there will be no leakage of the aggregate into the weigh box. If one weigh box is used it shall be of sufficient capacity to hold a complete batch of aggregates without wasting or levelling by hand and shall be so designed that the entire batch will discharge quickly into the mixing unit. Separate weigh boxes may be used, but when used the arrangement shall be such that the aggregate from the separate weigh boxes will discharge cleanly and quickly into the mixer. The weigh box shall be open at the top so that if, in charging, an excess of one size of mineral aggregate is introduced into the weigh box, it may be removed by the operator. The weigh box shall be provided with a close fitting and quick operating cutoff gate so that there will be no leakage of the aggregate into the mixing unit.

**(c) Bitumen Bucket.** The bucket for weighing the bitumen shall have sufficient capacity to hold not less than twenty (20) percent of the weight of aggregate required for one batch. The specified temperature of bitumen in the pipe lines, meters, weigh buckets, spray bars and other containers or flow lines shall be maintained by steam jackets, so designed that steam will not be introduced into the bitumen, or by properly insulated electrical heating units, or by other means, as approved by the engineer. The bitumen bucket shall be suspended on beam type scales equipped with a tell-tale so that the tare weight of the bucket will be shown for each weighing and the net weight of the bitumen measured accurately to within three-tenths (0.3) of one (1) percent from the

weight required. The bucket shall be so arranged that it will deliver the heated bitumen in a thin uniform sheet or in multiple streams to full width of the mixing unit.

**(d) Mixing Unit.** The mixing unit shall be of the twin-shaft, pugmill batch type and shall have a minimum batch capacity of two-thousand (2,000) pounds. The number and arrangement of the blades shall be such as to give a uniform and complete circulation of the batch in the mixing unit. Any mixing unit that has a tendency to segregate the aggregate or fails to secure a thorough and uniform mixing with the bitumen will be condemned.

The mixer box, if not enclosed, shall be provided with suitable means to prevent loss of dust by dispersion. The mixing unit shall be so constructed as to prevent leakage of contents until the batch is to be discharged and shall be equipped with a lock timing device by means of which accurate control of the mixing cycle can be accomplished. The time of mixing shall be considered as the interval between the time the asphalt is spread on the aggregate and the completed mixture is discharged from the mixing unit.

**35.06 CONTINUOUS FLOW PLANT. (Special Requirements)** **(a) Aggregate Control Unit.** In addition to the specification of bins for all plants, the following requirements are necessary:

Each bin being used shall be so equipped that a uniform head of aggregate shall be maintained in the bin or bins and the feeding units to obtain a uniform flow of aggregate. They shall be equipped with an indicator to show when the level in the bin has reached a certain established minimum. The plant operator shall halt mixing operations when the aggregate level reaches this minimum, and allow the bins to gain fill. A cutoff system will also be required which automatically stops mixing operations when the minimum level in the bin has been reached. Each bin shall have an overflow spout to control the top level of the aggregate in the bin.

The volumetric proportioning device for each bin containing aggregate shall be equipped with an accurately controlled and calibrated gate or other approved device for volumetrically measuring the dried aggregate as it is fed to the mixing unit and shall be so constructed that the flow of aggregate can be accurately determined and positively controlled. The gates also shall be constructed so that they can be locked or bolted in the position as set by the engineer. Means shall be provided for calibration of gate openings with test samples drawn from the gate and weighed. The contractor shall provide a small platform scale of approximately five-hundred (500) pounds capacity and containers of adequate size for this purpose.

**(b) Bitumen Control Unit.** The volumetric proportioning device for the bitumen shall be a rotating, positive displacement, bitumen metering pump with a satisfactory nozzle arrangement at the mixing unit. The operating speed of the



pump shall be synchronized with the flow of aggregate to the mixing unit by an automatic interlocking control and the device shall be easily and accurately adjustable to vary the quantity of bitumen delivered to the mixing unit so that the resulting mixture will be uniformly proportioned within the established limits. Means shall be provided for accurately checking the rate of flow of bitumen into the mixture.

(c) **Mixer Unit.** The plant shall include a continuous mixing unit of an approved twin-shaft, pugmill type, steam-jacketed and capable of producing a uniform mixture within the job-mix tolerance. The paddles shall be adjustable for angular position on the shafts and reversible to retard the flow of the mix. The mixing unit shall carry a manufacturer's plate, giving the net volumetric contents of the unit at the several heights inscribed on a permanent gauge and also giving the rate of feed of aggregate per minute, at plant operating speed. The resulting mixture of the continuous flow plant shall be comparable, in quality and uniformity, to that obtained by the weight batching type of plant.

**35.07 ROADWAY EQUIPMENT. (Requirements)** (a) **Motor Graders.** Motor graders in good mechanical condition, of adequate tractive power, weighing not less than twenty-thousand (20,000) pounds, equipped with mold boards not less than twelve (12) feet in length, may be used to spread bituminized material for levelling and shaping the roadway base section. Other mechanical methods which will secure satisfactory results may be used when approved by the engineer. Levelling and shaping and/or otherwise truing the roadway section, while incidental to, does not compose surface course construction.

(b) **Pavers.** Spreading, shaping and finishing of the surfacing course or courses of bituminized mixture shall be done by one or more self-contained, self-propelled units or pavers, operated in such manner that no supplemental spreading, shaping or finishing will be necessary to provide the surface smoothness required. (See Article 35.11.) Pavers shall contain an integral, activated screed or strike-off assembly, heated if necessary, and shall be capable of spreading and finishing the surfacing course to not less than the full width of a traffic lane and from three-fourths ( $\frac{3}{4}$ ) inches to six (6) inches in depth, true to line, grade and crown of the typical section of the plans. The screed or strike-off assembly shall operate by cutting, crowding or other practical action which is effective on bituminous mixtures without tearing, shoving or gouging and produces a finished surface of uniform texture devoid of segregation. The unit or paver shall be provided with rolling, tamping or other suitable devices so as to produce a surface course uniformly dense throughout, smooth and free from inequalities and irregularities. The screed shall be adjustable horizontally with an indicating level attached in full view of the operator.

The paver receiving hopper shall have sufficient capacity for dumping trucks to avoid decrease in speed or efficiency of the paver and prevent unnecessary delay of dump trucks

during spreading operations. Pavers shall be fitted with mechanical devices, such as equalizing and straightedge runners, eveners arms and/or other devices for confinement of the surfacing course edges to true lines and for the purpose of compensating grade and surface irregularities in the base and prevent their reflection in the finished surface. Should conditions indicate the advisability, and when ordered by the engineer, a levelling attachment of approved design, capable of extending the paver wheelbase by approximately twice its length, shall be attached to the paver for spreading levelling material and for placing the first course of the surfacing as a step toward developing the finished surface smoothness required. Additional paver equipment will include blending or joint levelling attachments for smoothing and adjusting longitudinal joints between abutting strips of surfacing courses and a device for forming beveled edges of the surfacing courses when required.

Pavers shall be equipped with power and traction adequate to their efficient operation on ascending grades of seven (7) percent while pushing a loaded truck; be possessed of quick and positive steering ability and capable of operational speeds commensurate with satisfactory placing of the surfacing course mixture.

(c) **Trucks.** Trucks, in number consistent with production for hauling bituminous mixtures, shall have tight, clean, smooth metal beds that may be lightly sprayed with an in-excessive amount of thin fuel oil, paraffin oil or soap solution to prevent the mixture from adhering to the truck beds. Upon completion of spraying, if necessary, any excess amount of such oil or solution remaining in the truck body shall be immediately disposed of before loading the bituminized mixture. Any truck causing excessive segregation of material by its spring suspension or other contributing factors, that shows oil leaks of any magnitude, or that causes undue delays, upon direction of the engineer, shall be discharged from the work until such conditions are corrected. When the length of haul tends to excessive heat loss of the mixture, or when weather conditions are such as to necessitate such protection, each load shall be covered with a tarpaulin, while in transit, to prevent unnecessary loss of heat and protect the mixture from the weather.

(d) **Rollers.** Rollers shall be the types specified in Paragraph (a), 2 and 3 and Paragraph (c), Article 14.02, Section 14.

**35.08 PREPARATION OF AGGREGATE.** Aggregates shall be dried and heated at the plant so that when delivered to the mixing unit they shall be at as low a temperature as is consistent with proper mixing and laying and in no case to exceed 325°F. Drying shall continue for a sufficient time and at a sufficiently high temperature, consistent with this specification, to cause the aggregate to become thoroughly surface dry and to the extent that the total moisture content for Types II and III shall not exceed one and one-half (1½) percent by



weight prior to bituminizing. If bituminized mixture contains evidence of excessive moisture, the production of the plant shall be regulated in such manner that the aggregate can be properly dried.

Immediately after drying, the aggregate shall be screened into the bin sizes specified. All aggregates shall be stored in such manner as to control the temperature within the limits prescribed for mixing and to prevent accumulation of moisture.

Additional filler, if required to meet the grading requirements, shall be proportioned and blended with the mineral aggregate before being screened into the separate bins. Filler may be added to the aggregate at the mixing plant by pre-mixing it thoroughly with the other fine aggregates or by feeding it into either the hot or cold elevator. Spreading filler over the tops of the aggregate piles or dumping it into the hoppers at crushing plants will not be permitted.

**(1) TYPE I PLANT MIX SURFACING.** It is the objective of this provision to prepare and construct a plant mix surfacing utilizing road mix aggregates. The moisture content of the aggregate used in Type I Plant Mix Surfacing shall not exceed three (3.0) percent by weight prior to bituminizing.

Aggregate for Type I Plant Mix Surfacing shall be the type and grading specified in the proposal.

Separation of the aggregate into fractions at the plant will not be required. Delivery of aggregate to the plant shall be from a stockpile, prepared in advance of the mixing operations. The stockpile always shall contain a quantity of material sufficient for one (1) day's operation of the mixing plant. In no instance will it be permissible to charge the plant directly from the crushing and/or screening plant. Extreme care shall be exercised in the selection of the materials in order that the aggregate delivered to the plant will be uniform in grading and will not contain any deleterious material.

The aggregate for the bituminous mixture will be sampled and tested immediately upon delivery from the drying unit. Should there be any oversize material, or an excess of material passing the No. 200 mesh sieve present, the mixing plant shall be so regulated that the oversize material and excess material passing the No. 200 mesh sieve can be removed prior to preparing the bituminous mixture.

**(2) TYPE II PLANT MIX SURFACING.** Aggregate for Type II Plant Mix Surfacing shall be the type and grading stipulated in the proposal. After drying, and prior to mixing with the bituminous material, it shall be separated by screening it into at least two (2) sizes, and stored in separate bins. One bin shall contain that portion of the aggregate retained on the No. 4 sieve and one bin shall contain that portion of the aggregate passing the No. 4 sieve. There shall be no carryover of either size aggregate into opposite bins at any time. The two (2) sizes shall later be combined in the directed proportions upon charging the mixing unit.

(3) **TYPE III PLANT MIX SURFACING.** Aggregate for Type III Plant Mix Surfacing shall be of the type and grading stipulated in the proposal. After drying and prior to mixing with bituminous material it shall be separated, by screening, into three (3) or more bins as specified and stored in separate bins.

**35.09 PREPARATION OF BITUMINOUS MIXTURE.** The hot aggregate, prepared as herein prescribed, shall be accurately measured and conveyed into the mixing unit in the proportionate amounts of each aggregate required to meet the specified grading. The aggregate shall be introduced into the mixing unit at a temperature of (a) not more than 225°F. when cutback liquid asphalt is used and (b) not more than 325°F. when asphalt cement or slow-curing liquid asphalt is used. IN NO CASE shall the aggregate be introduced into the mixing unit at a temperature more than 25°F., above the temperature of the bitumen.

When batch type mixing units are used the mixture shall be made by first charging the mixing unit with the mineral aggregates and dry mixing for a period of five (5) to ten (10) seconds after which the bituminous material shall be added and the mixing continued for a period of not less than thirty-five (35) seconds, or longer if necessary, to produce a homogeneous mixture in which all particles of the aggregate are uniformly and thoroughly coated.

When continuous flow type plants are used, unless otherwise required, determination of mixing time shall be by weight under the following formula. The weights shall be determined for the job by tests made by the engineer:

$$\text{Mixing time in seconds} \times \frac{\text{Pugmill dead capacity in lbs.}}{\text{Pugmill output in lbs./sec.}}$$

In no case shall the mixing time be less than forty (40) seconds.

The pugmill blades shall be capable of adjustment so as to retard the flow of material through the mixing unit as may be required to produce a homogeneous mixture in which all particles of the aggregate are uniformly and thoroughly coated.

In order to prevent segregation, loading of the bituminous mixture from a continuous flow type plant into trucks shall be at the rate consistent with the full discharge of the mixing unit.

**35.10 CONSTRUCTION METHODS.** (a) **Weather and Seasonal Limitations.** Plant mix bituminous surfacing shall be placed only during daylight, when the air temperature is 40°F. and rising and the road surface is dry. The mixture shall not be placed when, in the opinion of the engineer, the weather or road conditions are unfavorable.

(b) **Existing Surface Preparation.** When not included in the other phases of a contract, preparation of the existing surface shall be performed in accordance with the pertinent requirements of Subsection 16.10, "Existing Surface Preparation."

(c) **Prime or Tack Coat.** When directed, a tack coat or prime coat of bituminous material shall be applied in the amount and over the area designated.

(d) **Protection of Traffic and Roadway Structures.** (1) Traffic protection shall be performed in accordance with the provisions of Schedule 1, Article 16.31, Subsection 16.30, "Traffic Provisions."

(2) **Protection of Highway Structures.** Shall be performed in accordance with the pertinent provisions of Article 33.05, Section 33, "Bituminous Surface Treatment."

All equipment shall be removed from the road at the conclusion of the day's work.

(e) **Transportation and Delivery of Mixture.** Upon being discharged into the hauling unit, the bituminous mixture shall be weighed on previously described scales and transported from the plant to the point of placing in pneumatic-tired vehicles hereinbefore described. The bituminous mixture shall be delivered to the point of use at such temperature between 200°F., and 325°F., as the engineer may direct. When the mixture is being placed during warm weather and the engineer has determined that satisfactory results can be obtained at lower temperatures, he may direct that lower temperatures than those specified may be permitted.

(f) **Placing Plant Mixed Surface Course.** Levelling material or surface course construction on irregular or small areas, approaches, turnouts, etc., not readily accessible to a paver may be spread and finished by a motor grader, or it may be placed, raked and levelled by hand methods, as directed. All surface course or courses shall be spread, levelled and finished to line and grade and in conformance with the typical section and surface smoothness required.

Plant mixed surfacing shall be delivered to the job and spread at the minimum workable temperature which will produce the density and texture described herein, after final rolling. Unless otherwise specified in the plans or proposal, plant mixed surfaces shall be constructed in two (2) or more courses of approximate equal compacted thickness with the "first course" being slightly greater in depth than the "final course."

Sequence of construction "first" and "final" courses shall be practical to the contingencies of operational, construction or weather conditions existent or occurring upon the project which might be reflected detrimentally or beneficially in the quality of the completed surfacing. Placing of the "final" course shall follow "first" course construction, not later than that time, when it is determined by the engineer that proper bonding of the two courses is obtainable.

One edge of the surfacing course being spread shall be established by the engineer, with a string or wire furnished by the contractor, in advance of spreading any course. Placing of any course shall be as continuous as possible and the roller shall pass over the unprotected edge of freshly spread

mixture only when spreading of this course is to be discontinued for such length of time as to permit the mixture to become chilled.

In these cases, including the formation of joints as hereinafter specified, provisions shall be made for proper bond with the new surface for the full depth of the course. Joints shall be formed by cutting back on the previously spread course in order to expose its full depth. When spreading of the course is resumed, the exposed edge of the joint shall be painted with a thin coat of bituminous material. The freshly spread mixture shall be raked against the joint, thoroughly tamped with hot tampers and rolled.

The mixture shall be spread and laid with a minimum of cold, longitudinal joints between finished lanes. The lanes shall be as long as practicable in order that hot, longitudinal joints can be made at all times between successive lanes during the progress of the day's run. Longitudinal and transverse joints shall be formed with utmost care and precision of workmanship in order that there will be a complete bonding of the courses and coincidence to surface planes devoid of ridges or depressions at the joints, which will not be tolerated. Joints accumulating dust, mud or other foreign matter shall be trimmed back sufficiently to permit proper bonding of the abutting courses. All concrete or metal structures, such as curbs, gutters, manholes, inlets, valve boxes and headers, shall be painted with a thin coat of bitumen, approved by the engineer, on the area which will be covered by plant mix material.

Where mechanical methods do not produce the proper bond at joints, gutters, curbs or structures, hand methods will be required for filling, spreading, raking and tamping in obtainance of satisfactory results. Hauling over surfacing already placed will not be permitted until the mixture has been thoroughly compacted in the manner specified and it has cooled to atmospheric temperature.

**(g) Compaction.** In order to develop the specified thickness, the weight of mixture in place per square yard shall be adjusted to provide the compacted thickness specified. The compaction shall be estimated from the formula: (a)  $W = 0.85 \times G \times 62.4 \times 0.75$  or (b)  $W = 0.85 \times G \times 62.4 \times 0.90$

Where: (a)  $W$  = The compacted weight per square yard of the bituminous mixture one inch in thickness.

or: (b)  $W$  = The compacted weight per square yard of the bituminous mixture one-tenth (0.1) of a foot in thickness.

$G$  = The specific gravity of the mineral aggregate.

$62.4$  = Factor for converting a cubic foot of water to pounds.

Compaction operations shall be performed in accordance with the pertinent requirements of Section 14, "Rolling."



**35.11 SURFACE SMOOTHNESS.** The finished surface shall be free from defects and depressions exceeding one-eighth ( $1/8$ ) inch, as measured with a ten (10) foot straightedge, paralleling the center of the roadway and shall have an entirely smooth riding quality.

**35.12 METHOD OF MEASUREMENT.** (a) Plant mixed surfacing, composed of all ingredients in the completed mixture, will be measured by the ton of two-thousand (2,000) pounds, after mixing, weighed in the hauling unit on specified scales.

(b) Bituminous material will be measured in accordance with the requirements of Section 30, "Bituminous Material."

Other contract items will be measured in accordance with the requirements of the respective specification.

**35.13 BASIS OF PAYMENT.** Plant mixed surfacing, used in the completed and accepted work, will be paid for at the contract unit bid price. This price and payment, except as may be otherwise specified, shall be full compensation for furnishing all labor, tools, materials, (except bituminous material) and equipment, used in preparing the bituminous mixture and performing the work; for hauling, placing, spreading and rolling all plant mixed levelling and surfacing material and all manipulations and incidentals necessary to complete the work.

Bituminous material used in the accepted mixture and for tack or prime coat will be paid for at the contract unit bid price, in accordance with the requirements of Section 30.

Bituminous material used in painting joints, gutters, headers, manholes, curbs, etc., covered in Paragraph (f), Article 35.10, will be paid for at the contract unit bid price in accordance with the requirements of Section 30, "Bituminous Materials," and shall include all labor, tools and incidentals necessary to complete the work.

"Existing Surface Preparation," unless otherwise specified, will not be paid for separately but will be considered necessary and incidental to the performance of and payment for the other items of the contract and shall include all labor, equipment, tools and incidentals necessary to complete the work.

Other contract items will be paid for at the contract unit bid prices, in accordance with the requirements of the respective specifications.



Item No.	Item Description	Unit
TYPE I		
3511	Plant Mix Bituminous Surf. (Inclusive of all courses)	Ton
3512	Plant Mix Bituminous Surf. (to be used as levelling material)	Ton
3513	Plant Mix Bituminous Surf. (to be used as 1st course const.)	Ton
3514	Plant Mix Bituminous Surf. (to be used as 2nd or final course construction)	Ton
TYPE II		
3521	Plant Mix Bituminous Surf. (Inclusive of all courses)	Ton
3522	Plant Mix Bituminous Surf. (to be used as levelling material)	Ton
3523	Plant Mix Bituminous Surf. (to be used as 1st course const.)	Ton
3524	Plant Mix Bituminous Surf. (to be as 2nd or final course construction)	Ton
TYPE III		
3531	Plant Mix Bituminous Surf. (Inclusive of all courses)	Ton
3532	Plant Mix Bituminous Surf. (to be used as levelling material)	Ton
3533	Plant Mix Bituminous Surf. (to be used as base course const.)	Ton
3534	Plant Mix Bituminous Surf. (to be used as wearing course construction)	Ton



## SECTION 36

### SEAL COAT



**36.01 DESCRIPTION.** "Seal Coat" shall consist of a surface treatment composed of a single application of bituminous material on an existing bituminous surface, immediately followed by covering with aggregate of the type stipulated in the proposal and/or shown on the plans, in conformity with the plans for the work thereof and these specifications. When stipulated in the proposal and/or in the plans, the bituminous material may be applied without cover.

**36.02 MATERIAL.** (a) Bituminous material of the kind and grade stipulated in the proposal and/or shown on the plans shall meet the requirements of Section 30, "Bituminous Materials." It is understood that the variables of natural conditions and materials which it is not possible to predetermine, may develop the requirement for adjustments of the application rate of bitumen during the course of the work.

(b) Cover aggregate may be produced under the contract for seal coat or it may be obtained from stockpiles produced under a previous contract, as stipulated in the proposal and/or shown on the plans. It is understood that the variables inherent of materials and natural conditions, which it is impossible to predetermine, to be encountered in performing this work, may develop the requirement for adjustments in the application rate of cover aggregate during work performance.

(c) Quantities of bitumen and aggregate will be as specified in the plans or as directed by the engineer.

**36.03 EQUIPMENT.** The equipment used in this operation shall comply with the pertinent provisions of Article 33.03, Section 33, "Bituminous Surface Treatment," and with references made therein.

**36.04 CONSTRUCTION METHODS.** (a) **General.** Seal coat operations shall not be performed prior to May 15th, nor shall they be continued later than September 15th. No bituminous material shall be applied when the roadway surface is damp or wet, or when the atmospheric temperature, or the temperature of the oil mat to which the material is being applied is less than 65°F., and rising, or weather conditions are such that the bitumen will become chilled before the cover material can be spread and rolled. Work shall not be started without consent of the engineer and shall be promptly terminated in the event of rain or the occurrence of unfavorable road or weather conditions.

In no event shall the seal coat be placed on newly constructed or reconditioned surfaces in less than ten (10) days after such surface has been constructed. Bitumen and aggregate for seal coat shall not be placed upon a plant mix bituminous surface sooner than twenty-one (21) days after placement of said surface.

(b) **Sweeping.** Directly in advance of the first application of bituminous material, the roadway surface shall be swept clean of all dust, dirt, or foreign matter, by means of

a power broom, blower or hand brooming, when required for satisfactory cleaning of the surface. Water washing may be required to remove agglomerated clay, shale or other material that resists removal by mechanical or hand methods.

Such cleaning will not be measured nor paid for directly but shall be considered incidental to the other items of the contract.

If the surface texture on which the seal coat is being constructed is such as to permit rapid absorption, the engineer may direct a preliminary application at a rate of approximately one-tenth (0.1) gallon per square yard of the type bitumen as specified for the seal coat. Such application will be measured and paid for as provided under Articles 33.06 and 33.07.

**(c) Application of Bitumen.** Immediately following the cleaning, the first application of bitumen shall be uniformly applied, at the application temperature and at the rate per square yard directed by the engineer, by means of a pressure distributor of the type described. Extreme care shall be taken in application of the bitumen to secure uniform surface cover and true lines.

**(d) Application of Cover Material.** The contractor shall not proceed with the application of bitumen until a supply of aggregate sufficient to cover the entire application is immediately available for covering the bitumen in not less than five (5) minutes. Spreading of cover material shall be made promptly on the freshly spread bitumen, when the engineer determines that its consistency has become such that the best "keying" results will be obtained. In the instance of an emulsified asphalt type of bituminous material, cover aggregate shall not be applied until the emulsion starts to "break" and it begins to turn black in color.

The bitumen application shall be promptly covered with the specified cover material, at the rate directed by the engineer, spread uniformly over the bitumen with a self-propelled or truck mounted mechanical spreader, with rate of application control independent of the motive power previously approved by the engineer. Aggregate spreaders that fail to make a uniform and satisfactory distribution of material shall be promptly removed from further use. Special care must be exercised in the spreading of cover material in order that uniformity of cover and longitudinal lines will be secured. Operation of the spreader motive equipment shall, at all times, be assigned to the same experienced operator.

Brooming by mechanical or hand methods, if directed by the engineer, shall be employed to insure uniform distribution of the cover material. When brooming is resorted to, particular caution must be exercised to avoid displacement or loosening of particles of cover material from the bitumen.

Bituminous material application shall not be made to such a distance that uncovered bitumen in "meet line" areas will become chilled to such extent during the time interval,

that it will not successfully "key" the maximum amount of cover aggregate. Bitumen must be applied in such manner and with such care that transverse and longitudinal joints or "meets" of successive applications will not result in ridges or depressions and will be smooth, consistent with the adjacent surface of the completed treatment.

Longitudinal laps (meet lines) may be from six (6) to ten (10) inches in width, but there shall be no overlap at the end junction of applications. In order to prevent lapping at transverse junctions, the distributor shall be promptly shut off and, if necessary to prevent dripping, a drip pan shall be inserted under the nozzles when the application begins to thin. Before continuing application of the bitumen, building paper or metal sheets shall be spread over the treated surface for sufficient distance back from the joint on the cover aggregate so that the sprayers are operating at full force upon reaching the surface to which application is to be made. Any paper used for covering joints shall be removed and destroyed.

All transverse joints shall be covered with aggregate and shall be broomed back before the next longitudinal application of bitumen is made. When it is necessary to cover "meet lines" to permit trucks or traffic to cross over, such cover aggregate shall be neatly broomed back exposing the full width of the meet line before the abutting application of bitumen is made.

There shall only be permitted a minimum number of meet lines, compatible with the width of the roadway surface. Permission may be granted by the engineer to make full road surface width application of bitumen and cover aggregate, to be performed in a single continuous operation, so coordinated that the movement of public traffic will not suffer greater inconvenience than that resulting from strip or half roadway width methods.

**(e) Rolling.** Rolling of cover aggregate shall be in accordance with the provisions at Section 33, Article 33.04, Paragraph (e).

**(f) Opening to Traffic.** Upon completion of this cover aggregate course, the surface shall be opened to traffic for a period of two (2) days, with the period of specified traffic control in effect. During this period the surface shall be maintained by brooming and/or rolling, as directed by the engineer. Any holes or breaks that may occur shall be satisfactorily repaired. Any areas showing excess bitumen shall be covered with aggregate and rolled. Any irregularities influencing the stability and riding quality of the surface shall be corrected in satisfactory manner. Cost of any such repairing or corrections shall not be paid for directly but shall be included in the other bid items in the contract.

When called for in the proposal and/or if directed by the engineer, the cover material for any course may be wetted by watering, prior to spreading it upon the bituminous material. If wetting is required, it shall be performed subsequent to weighing of the cover aggregate.



Trucks hauling cover material to the spreader units or traffic shall not be permitted at any time, or under any circumstances, to cross over or drive on any uncovered bituminous material. When operating over freshly spread cover material, the speed of vehicular traffic shall be so regulated that loosening and displacement of cover material shall not occur. Trucks failing to observe this requirement shall be promptly dismissed from the work.

**36.05 PROTECTION OF TRAFFIC AND HIGHWAY STRUCTURES.** The requirements and provisions of this article shall be the same as those set forth under Article 33.05, Section 33.

**36.06 METHOD OF MEASUREMENT.** (a) Bituminous material used in the completed and accepted work will be measured by the U. S. gallon, or by the ton, as stipulated in the proposal and in accord with Section 30, "Bituminous Materials."

(b) Cover material used in the completed and accepted work will be measured by the ton on scales furnished by the contractor, or by the cubic yard, measured in the vehicle at point of delivery on the roadway, as stipulated in the proposal and in accord with Section 20, "Aggregate Surfacing—General Conditions."

(c) Rolling will be measured and provided for in Section 14, "Rolling."

(d) Watering will be measured by the unit stipulated in the proposal and in accord with Section 15, "Watering."

(e) Other items specified in the contract will be measured as stipulated in the proposal.

(f) Traffic protection will not be measured unless specified otherwise.

**36.07 BASIS OF PAYMENT.** Application of bituminous material, cover aggregate, rolling, watering and/or any other items specified in the contract will be paid for at the contract unit price bid for the unit specified in Article 36.06 and/or the proposal, which prices and payment will be full compensation for furnishing all materials, unless otherwise indicated in the proposal; for delivering, preparing, handling and placing all materials and for all other charges; for maintenance of the completed surface until acceptance and for all manipulations, labor, tools, equipment and all incidentals necessary to complete the work.

Item Description	Unit	Item No.	Unit	Item No.
Application of $\frac{5}{8}$ " Cover Material	Cubic Yd.	3611	Ton	3612
Application of $\frac{1}{2}$ " Cover Material	Cubic Yd.	3621	Ton	3622
Application of $\frac{3}{8}$ " Cover Material	Cubic Yd.	3631	Ton	3632
Application of $\frac{1}{2}$ " Stone Chips	Cubic Yd.	3641	Ton	3642
Application of $\frac{3}{8}$ " Stone Chips	Cubic Yd.	3651	Ton	3652
Application of Sand	Cubic Yd.	3661	Ton	3662



**SECTION 39**

**PORTLAND CEMENT  
CONCRETE PAVEMENT**



**39.01 DESCRIPTION.** "Portland Cement Concrete Pavement" shall consist of a single course of air-entrained Portland Cement Concrete with or without reinforcement, constructed on a foundation course or on a prepared subgrade in accordance with these specifications and in conformity with the lines, grades, sections, thicknesses and typical cross sections shown on the plans or as directed by the engineer.

**39.02 MATERIAL. (1) Concrete.** Concrete shall be composed of Portland Cement, fine aggregate, coarse aggregate, and air-entraining agent and water, and shall conform to the requirements for Class "AD" Concrete, as specified in Subsection 46.00 unless specified otherwise on the proposal form and as may be modified by the special provisions.

**(2) Cement.** Portland Cement shall conform to the requirements of A.A.S.H.O. Specification M-85, Type II, unless specified otherwise in the special provisions. "Cement" also shall conform to the provisions of Paragraph (a) 1, Article 46.04, Subsection 46.00, unless modified by the special provisions.

**(3) Air-Entraining Admixtures.** Air-entraining admixtures shall be in accordance with air-entraining admixtures for concrete, A.A.S.H.O. Designation M-154 and as modified by the special provisions. The air content shall be not less than four (4) percent nor more than seven (7) percent as determined by the pressure method, A.A.S.H.O. Designation T-152.

**(4) Fine Aggregates.** The fine aggregate shall conform to the provisions set forth in Paragraph (c) 1, Article 46.04, Subsection 46.00. Gradation shall conform to Table 'B' of that paragraph.

**(5) Coarse Aggregates.** The coarse aggregate shall conform to the provisions set forth in Paragraph (c) 2, Article 46.04. Gradation shall conform to Table 'B' of that paragraph.

**(6) Water.** Water used in concrete shall conform to the provisions set forth in Article 46.04.

**(7) Reinforcing Steel.** Steel-wire fabric or steel bar mats, when called for, shall be of the sizes and dimensions and located as shown on the plans.

Steel-wire fabric reinforcement shall conform to the requirements of A.A.S.H.O. Designation M-55. It shall be furnished in flat sheets.

Bar mats shall conform to the requirements of A.A.S.H.O. Designation M-54 and the bars used shall conform to the requirements of billet steel bars for reinforcement, A.A.S.H.O. Designation M-31, structural or intermediate grade, as specified.

**(8) Dowel Bars.** The dowel bars shall be plain round bars of intermediate grade open-hearth steel conforming with the standard specifications for billet-steel bars for reinforce-

ment, A.A.S.H.O. Designation M-31. The dimensions of the bars and their positions in the pavement shall be as shown on the plans or as directed by the engineer.

(9) **Tie Bars.** Tie bars shall be bare of structural or intermediate grade open-hearth steel conforming to the standard specifications for billet-steel bars for concrete reinforcement, A.A.S.H.O. Designation M-31. They shall be of an approved deformed type, but they shall not be the cold twisted type. The length, size and spacing of the bars shall be as shown on the plans or as directed by the engineer.

(10) **Expansion Joint Filler.** Expansion joint filler, whenever called for on the plans, shall conform to A.A.S.H.O. Designations M-90 or M-153. A.A.S.H.O. Designation M-90, redwood board expansion joint filler generally will be used for all newly constructed expansion joints. A.A.S.H.O. Designation M-153, Performed expansion joint filler, will usually be used at joints between the concrete pavement and structure in place.

(11) **Joint Sealing Material.** The sealing material for sealing all types of pavement joints shall be a hot poured thermoplastic rubber or rubber asphalt compound complying with Federal Specification SS-S-164, and shall be furnished in one grade only.

Ready mixed cold applied joint fillers for sealing joints in concrete pavement will not be permitted except by prior written approval of the engineer.

The State reserves the right to order discontinued the use of any joint filler material which, in the opinion of the engineer, fails to produce a satisfactory joint under the methods employed by the contractor.

(12) **Subgrade Paper.** Subgrade paper, if called for on the plans, shall conform to the requirements of A.A.S.H.O. Designation M-74.

(13) **Foundation Course.** When a foundation course is called for, it shall be pit run gravel, shale, scoria, sand, disintegrated granite, crushed gravel or stone and filler, or similar materials from authorized sources designated by the engineer, and shall conform to the pertinent provisions of Sections 20, 21, 22, 23, 24 or 25, whichever is called for in the proposal and special provisions. This item shall be placed and compacted in conformity with the lines, grades and typical section shown on the plans. Granular or soil materials adequately stabilized with a cementing agent may also be used as directed by the engineer.

(14) **Shoulder Surfacing Material.** Shoulder surfacing material shall be material specified under (13), foundation course, or called for in the special provisions and shall be placed and compacted in conformity with the lines, grades and typical section shown on the plans.

(15) **Curing Compound.** Curing compound, when used, shall conform to the requirements of A.A.S.H.O. Designation M-148, Type 2, white pigmented, liquid membrane-forming compound.



**(16) Composition and Proportioning of Materials.** The composition of the concrete and the proportioning of the materials shall conform to the provisions of Paragraph (b), Method 'B,' Article 46.03, Subsection 46.00.

**39.03 EQUIPMENT. (1) Preliminary.** Before paving operations are started, the contractor shall have at the site and on the project, all equipment necessary for the proper preparation of subgrade, batching, paving, finishing and curing and all tools necessary for performing all parts of the work. The equipment shall be checked for mechanical condition and adjustment and the design, capacity and mechanical condition shall be approved by the engineer before any paving work is started. During paving operations, the contractor shall maintain all equipment in proper working order and adjustment and shall make any needed resetting or readjustment of the equipment, whenever required by the engineer, and if any equipment proves inadequate to obtain the results specified, such equipment shall be made adequate or other equipment shall be substituted which will obtain the specified results.

**(2) Water Supply.** When necessary for the supply of water for all operations described in these specifications, an adequate pipe line along the improvement, or sufficient tank capacity, shall be provided by the contractor. Any pipe line used must be fitted with drains at the low points and air relief valves at the high points and with convenient outlets for all paving operations.

The concrete pavement in place for five (5) days after placing and the subgrade or foundation course preparation shall have prior rights to the water supply. If it should develop that there is not sufficient water for all purposes, the concrete mixer shall be shut down until the water needs of the curing and subgrading operations have been cared for.

**(3) Side Forms.** Side forms shall be metal unless otherwise specified in the special provisions. Metal forms shall be of sufficient weight and strength to resist the pressure of the concrete and be of a design that can be rigidly held to proper line and grade.

Flexible or curved forms of proper radii shall be used for curves of one-hundred (100) feet radius or less. All side forms shall be heavy enough to support mechanical finishing machines, mechanical subgrader or similar heavy equipment. They shall be equipped with a device for holding abutting sections firmly in alignment, which device shall permit adjustment for horizontal and vertical curves. Forms eight (8) inches or more in height shall be at least eight (8) inches wide at the base; and in no case shall the width of base be less than eighty (80) percent of the height; forms less than eight (8) inches in height shall have a base width at least equal to the height of the forms. They shall be equipped with not less than three (3) staking points per each ten (10) feet of length with means of securely locking the form to

each stake. Flange braces and staking pockets shall extend outward on the base not less than two-thirds ( $2/3$ ) the height of the form.

The use of wooden forms will not be permitted except by written consent of the engineer and then only in case of necessity. When used, side forms of wood shall conform to the requirements for steel forms as to lines, grade and height.

**39.04 CONSTRUCTION METHODS. (1) Preparation of Subgrade or Foundation Course.** After the roadbed has been finished and compacted in accordance with the requirements of Section 11, the subgrade, or foundation course if called for, shall be placed, trimmed, shaped and compacted to the lines, grades and typical cross section shown on the plans or staked by the engineer and for an additional distance of two (2) feet on each side, beyond the pavement width, and in accord with the requirements of Section 20. The surface of the subgrade or the foundation course shall conform to the lines, grades, crown and typical sections shown on the plans and to the requirements of Article 20.06, surface smoothness, prior to setting the forms.

After the forms have been set and approved by the engineer, the subgrade or foundation course shall be reshaped and recompacted by accepted rollers or compactors operating between the fine grading equipment and the paver. The subgrade or foundation course shall be tested in advance of the paver for crown, profile elevation and surface smoothness, by the use of an approved template held in a vertical position and moved backward and forward on the forms. The template shall be mounted on visible rollers and shall be designed so that its toothed edge conforms to the required shape of the subgrade and so that, when riding vertically on the forms, the toothed edge will represent the subgrade surface. Any excess material represented by this template shall be removed. Low areas likewise found shall be brought up to the correct elevation with approved subgrade or foundation material and compacted to the density specified for the embankment.

Equipment used in such a manner as to cause ruts in the finished subgrade or foundation course shall be corrected or removed from the work. The finished subgrade or foundation course shall be maintained in a smooth, compacted and undisturbed condition until the pavement is placed.

The subgrade or foundation course shall be in a moist but not muddy condition at the time of placing the concrete. If required by the engineer, it shall be wetted the previous night or not less than six (6) hours previous to the placing of the concrete. If it subsequently becomes dry, the subgrade or foundation course shall be sprinkled, but the method of sprinkling shall not be such as will form mud or pools of water.

**.04 (2) Form Setting.** The forms shall show no variation greater than one-eighth ( $1/8$ ) inch from the true plane of the face or top of the forms. The forms shall be free from warp, bends or kinks.

The foundation course or the subgrade, under the forms, shall be hard and cut true to grade so that the form, when set upon it, will be firmly in contact for its whole length and exactly at the desired grade. Any foundation course which, at the form line, is found below the established grade shall be filled to grade in lifts of one-half ( $\frac{1}{2}$ ) inch or less for a distance of eighteen (18) inches on each side of the base of the form and thoroughly compacted to the specified density. Imperfections and variations above grade shall be corrected by compacting or be thoroughly compacted after the form is set. No settlement or springing of forms under the finishing machine will be tolerated.

Conformity of the alignment and grade elevation of the forms with the alignment and grade elevation shown on the plans shall be checked, and any necessary corrections made by the contractor immediately prior to placing the concrete. Where any form has been disturbed or any foundation course thereunder has become unstable, the form shall be reset and rechecked.

Forms shall be set not less than three-hundred (300) feet in advance of the point where the concrete is being placed to insure proper construction and inspection of the foundation course. Forms shall remain in place at least twelve (12) hours after the concrete has been placed against them unless earlier removal is necessary to permit sawing of transverse weakened plane joints.

Forms shall be cleaned and oiled each time they are used. The contractor shall exercise extreme care in removing forms to avoid any damage to the pavement edges.

**.04 (3) Proportioning and Measuring.** The concrete shall conform to the mix designed by the laboratory which will produce concrete having a minimum strength of four-thousand (4,000) psi at twenty-eight (28) days using not less than six-and-one-half ( $6\frac{1}{2}$ ) sacks of cement per cubic yard and not more than six (6) gallons of water per sack of cement . . . it being understood that the proportions may be changed during the progress of the work and that they shall at no time be such that test cylinders of the resultant concrete will show compressive strengths of less than the design strength of four-thousand (4,000) pounds at twenty-eight (28) days.

(a) Measuring materials for job mixed concrete. Each kind of aggregate for each batch shall be weighed accurately and separately in an approved weighing device.

(b) Cement in unopened bags as furnished by the manufacturer may be considered to weight ninety-four (94) pounds. All cement must be weighed where batches are used that require fractional bags of cement.

(c) Water measuring equipment shall be accurate to within one (1) quart. The water storage tanks shall be so arranged that the measurement will not be affected by variations of pressure in the water supply line and will be accurate under all construction conditions.

(d) Scales for weighing aggregates and cement may be either horizontal beam or springless dial type designed as an integral unit of the batch plant, of rugged construction to withstand hard usage due to working conditions with an allowable error of one-half ( $\frac{1}{2}$ ) of one (1) percent of net load with significant graduation down to five (5) pounds. When beam scales are used, provision such as tell-tale dial shall be made for indicating to the operator that the required load in the weighing hopper is being approached, which device shall indicate at least the last one-hundred (100) pounds of load. Convenient means shall be provided for removing an overload from the hopper. Beam scales which are used for weighing more than one aggregate shall have an independent beam for each material being weighed. Scales shall be checked to assure accuracy after installation and before any proportioning of concrete begins.

**.04 (4) Consistency.** The consistency of concrete shall be measured as described in A.A.S.H.O. "Standard Method of Slump Test for Consistency of Portland Cement Concrete," Designation T-119. The slump of the various types of concrete for pavement shall be as follows:

Non-vibrated—machine finishing  $1\frac{1}{2}$ " to  $2\frac{1}{2}$ "

Non-vibrated—manual finishing 2" to 3"

**.04 (5) Flexural Strength.** The average flexural strength of concrete as determined by the laboratory test specified in A.A.S.H.O. Designation T-97 and A.A.S.H.O. Designation T-126 shall be not less than six-hundred (600) psi at twenty-eight (28) days.

**.04 (6) Mixing.** Either a central mixing plant or a central proportioning plant shall be used. The practice of distributing aggregate along or upon the roadway and feeding from there directly into the mixer will not be permitted.

Concrete shall be mixed in a batch mixer of approved type and capacity for a period of not less than one (1) minute after all the materials, except water, are in the drum. The mixer shall be operated at drum speed shown on the manufacturer's name plate. Any concrete mixed less than the specified time shall be dumped outside the work and removed at the contractor's expense. Except by written permission of the engineer, the mixer shall not be operated in excess of its guaranteed capacity as shown on the standard rating plate on the machine. Pick-up and throwover blades in the drum of the mixer, which are worn down three-quarters ( $\frac{3}{4}$ ) of an inch or more in depth, shall be replaced by new blades. After all materials are in the drum, the minimum mixing time shall be one-and-one-half ( $1\frac{1}{2}$ ) minutes for mixers up to one (1) cubic yard capacity with an increase of fifteen (15) seconds mixing time for each cubic yard or fraction thereof of additional capacity. The entire contents shall be removed from the drum before the succeeding batch is introduced. The skip and the throat of the drum shall be kept free and clean.



The mixer shall be equipped with an approved timing device which will automatically lock the discharge lever and release it only at the end of the mixing period; the device shall be equipped with a bell adjusted to ring each time the lock is released. Failure of the timing device shall be cause for the discontinuance of the use of the mixer until the device is repaired or a new timer substituted. The mixer may be used temporarily, however, providing the mixing time is increased fifty (50) percent and a suitable watch or clock is placed in full view of the mixing operator.

Retempering concrete by adding water or by other means will not be permitted. Concrete not in place within forty-five (45) minutes from the time the ingredients were charged into the mixing drum or that has lost plasticity to the extent that it will not meet slump requirements shall not be used. High early strength cement concrete will be subject to further appropriate limitations. Concrete shall not be mixed during cold weather. Materials containing frost shall not be used. Fine aggregate containing lumps or hardened material shall not be used.

Suitable equipment for discharging and spreading the concrete on the subgrade shall be provided. Tandem mixers will be permitted provided the mixer units are designed and built for synchronized operation. The mixing time hereinbefore required shall be exclusive of the time of transfer of materials between mixing drums or compartments.

**.04 (7) Ready-Mixed Concrete.** Transit-mixed concrete or concrete mixed in a central mixing plant shall be mixed and transported in accordance with the specifications for ready-mixed concrete, A.S.T.M. Designation C-94, and may be used only when approved in writing by the engineer.

When the use of transit-mixed concrete is permitted, the design of the mixing unit, water measuring equipment, water controls, the uniformity and adequacy of mixing, the method of discharging the concrete and any other special features shall be equivalent to the fixed type mixers specified herein, a suitable spreader shall be provided and all shall be approved by the engineer prior to use.

When the use of central mixing plants is permitted, the concrete shall be sized to such consistency that the hauling will cause no segregation of the constituent materials. The time elapsing from "mixing" to "placing" shall not exceed sixty (60) minutes and in no case shall concrete be placed which has lost plasticity to the extent that it is not within the specified slump limits.

Where concrete is to be transported more than five (5) miles, the vehicles shall be equipped with suitable devices for slowly agitating the concrete during transit or other equipment must be substituted which will insure the delivery of concrete which will meet all specification requirements at the time of placement in the forms. Prior to use, the central mixing plant and all equipment necessary for its operation, transportation and placing shall be approved by the engineer.



When a central proportioning plant is used the loose cement may be placed in batch boxes between the coarse and fine aggregate, provided that the batch boxes so loaded, which stand more than five (5) hours and less than eight (8) hours, shall have additional cement added thereto in an amount equal to twenty-five (25) percent of the standard quantity required, and batch boxes which stand eight (8) to twelve (12) hours shall have additional cement added thereto in an amount equal to fifty (50) percent of the standard quantity required. Materials in batch boxes, so loaded, which stand more than twelve (12) hours shall not be used. Where such method of loading is used, loaded batch boxes shall be suitably covered to exclude water in case of rain and to prevent loss of cement due to wind. Alternate methods of loading batched aggregates and cement must be approved, in writing, by the engineer prior to use.

**.04 (8) Placing Concrete.** The concrete shall be distributed to such depth above the grade that, when consolidated and finished, the slab thickness required by the plans will be obtained at all points and the surface will not at any point be below the grade specified for the finished surface.

Concrete shall be placed only on a foundation course, or subgrade, which has been approved. Concrete shall not be placed on a frozen foundation course or subgrade. At all times during operation, at least five-hundred (500) feet of foundation course, or one (1) days run of concrete shall have been prepared ahead of the mixer. No concrete shall be placed around manholes or other structures until they have been brought up to the required grade and alignment.

The concrete shall be deposited on the foundation course, or subgrade, in such a manner as to require as little re-handling as possible. Concrete along the forms shall be consolidated by vibration. Vibrators attached to the rear of the spreader or operated by hand from outside the forms will be permitted. Care shall be taken to insure that the concrete is not excessively vibrated.

Placing shall be continuous between transverse joints without the use of intermediate bulkheads.

Whenever it becomes necessary to stop the mixer, hand mixing shall be resorted to if necessary and a transverse construction joint shall be constructed as shown on the plans and as hereinafter specified. Except as above provided, no joint of any kind shall be placed across the pavement at any other location, than that shown on the plans or directed by the engineer. The pavement shall be constructed to its full width of the lane in a single construction operation. Longitudinal joints between lanes or sections shall be constructed in accordance with the details shown on the plans. Concrete in a longitudinal section shall not be placed until the adjacent parallel slab has attained an age of fourteen (14) days or has attained a modulus of rupture of six-hundred (600) pounds as shown by tests of standard specimens cured under the

same climatic and moisture conditions as the slab. The mixer shall be located outside the lane of pavement being laid unless otherwise permitted, in writing, by the engineer.

**.04 (9) Slip-Form Paver.** A slip-form paver may be used, in lieu of forms, provided the equipment and the proposed methods of operation are given prior approval by the engineer and subject further to the following modifications:

(a) All reference in these specifications to the construction requirements when forms are used shall be deleted and the procedure shall be modified to fit the use of the slip-form paver.

(b) The contractor shall provide an approved subgrade machine as described in Paragraph (1) of Article 39.04.

(c) The slip-form paver shall be equipped with a vibrator and tamping bar, extending over the full width of the surface and the concrete shall be held at a uniform consistency having a slump of not more than two (2) inches. If, at any time, it is necessary to stop the forward movement of the slip-form paver, the vibrator and tamping elements shall also be immediately stopped. Frequent stopping of the slip-form paver will not be tolerated. The contractor will be required to so organize his forces that a continuous deposit of concrete to the paver will be assured.

(d) The contractor will not be permitted to operate a mixing plant inside of the area to be transversed by the slip-forms that is to be paved.

(e) All contractional and longitudinal joints shall be sawed in accordance with the requirements specified in Paragraph (11) of this article.

(f) The edge of the slab shall be covered with curing compound as specified in Paragraph (15), Article 39.02.

**.04 (10) Handling and Placing Reinforcement.** The concrete shall be reinforced if and as designated on the plans. Reinforcing metal shall be kept clean and free from rust, straight and free from distortion, and shall be placed and held in position as detailed. All metal received on the job shall be held in approved storage and only such metal shall be distributed along the work as is needed for immediate placement.

When bar mat assemblies are shown on the plans, the reinforcement shall be assembled accordingly, firmly fastened together at all intersections. All adjacent ends shall lap not less than forty (40) diameters. Mat assemblies shall be placed by methods satisfactory to the engineer so that no displacement will occur during concreting operations. "Sleds" shall not be used except those shown on the plans and designed so as not to form planes of latent weakness. When steel fabric is required, it shall be placed in strips transversely with the roadway at the depth and with the lap shown on the plans. The fabric shall extend to within two (2) inches of the

ends and sides of the slabs. The concrete shall be struck off by means of a template at the indicated depth of the reinforcing below the finished surface of the slab. The fabric reinforcement shall then be placed directly upon the concrete and properly secured so that it will remain in place while concrete is placed above it.

**.04 (11) Joints.** All costs incidental to the joint construction shall be included in the original contract unit price for "Concrete Pavement." All constructed transverse and longitudinal joints shall be finished at the edge with an "edger" having a radius of one-eighth ( $\frac{1}{8}$ ) inch.

**(a) Transverse Expansion Joints.** Transverse expansion joints, when called for, shall be formed during the placing of the concrete and such methods of construction shall be employed that joints to the full depth and width of the slab are secured. The finished joint shall be true to the line prescribed within an allowable variation of one-quarter ( $\frac{1}{4}$ ) inch in the width of one (1) traffic lane.

The preformed expansion joint filler shall be redwood board expansion joint filler conforming to A.A.S.H.O. Designation M-90, shaped to the dimensions shown on the plans.

A string shall be stretched between the pavement forms along the centerline of the joint. The entire joint assembly shall then be carefully levelled up so that the dowels are held rigidly parallel to the pavement surface and parallel to the centerline of the pavement and free to slide in the dowel holes. Any grease scraped off the dowels in assembling the joint shall be replaced. Any excess grease on the dowel holders shall be removed.

The complete expansion joint assembly shall be placed directly beneath the string line so that the vertical plane of the joint will be perpendicular to the finished surface of the slab, and at right angles with the centerline of the slab.

Transverse expansion joints of the preformed type shall be formed by securely staking perpendicular to the proposed surface of the pavement and an approved "installing bar" or installing device, against which the preformed filler shall be fastened before placing the concrete.

The installing bar shall be a substantial metal plate or shape and shall have a length of one-half ( $\frac{1}{2}$ ) inch less than the proposed width of the slab in cross section with a width of one-fourth ( $\frac{1}{4}$ ) inch less than the proposed depth of the slab and shall be staked in position so that the top edge, unless otherwise provided on the plan, will be three-fourth ( $\frac{3}{4}$ ) inch below the proposed pavement surface; the lower edge shall be cut to conform to the prescribed cross section of the subgrade; the installing bar shall be slotted from the bottom as necessary to permit the installation of the required dowels and may be further cut away at intervals along its length so as to allow the concrete to make contact with the preformed filler at close intervals. Suitable means shall be provided on the bar for facilitating its removal. Header boards, sheet metal holders or other devices used in lieu of the installing bar shall be approved by the engineer.

The preformed joint filler shall be appropriately punched to admit the dowels. It shall be furnished in lengths of not less than ten (10) feet. Where more than one (1) section is allowed and used in a joint, the section shall be securely laced or clipped together. When in position, the filler shall be accurately perpendicular to the surface of the pavement. The bottom edge of the filler shall project to or slightly below the bottom of the slab and the top edge, unless otherwise prescribed, shall be held about three-fourth ( $\frac{3}{4}$ ) inch below the proposed surface of the pavement in order to allow the finishing operations to be executed continuously. The top edge of the filler shall be protected, while the concrete is being placed, by a metal channel cap of at least ten (10) gauge material, having flanges not less than one-and-one-half ( $1\frac{1}{2}$ ) inches in depth. The installing device may be designed with this cap, self-contained.

Where integral curb is shown on the plans, the joint filler shall provide full thickness of joint filler through the curb and shall be placed at the same position as that in the underlying pavement slab.

After the concrete has been placed on both sides of the joint and struck off, the installing bar shall be slowly and carefully withdrawn leaving the preformed filler in place. Before the installing bar and/or channel cap is completely withdrawn, the concrete shall be carefully spaded and additional freshly mixed concrete worked into any depressions left by the removal of the installing bar. The filler must be exposed for the full width of the slab. The installing bar shall be cleaned and re-oiled prior to each installation of a joint. After the removal of the side forms, the ends of the transverse joints at the edges of the pavement shall be carefully opened for the entire depth of the slab. Before the pavement is opened to traffic, preformed joints, in which the filler does not come flush with the surface, shall be sealed or topped out with the filler prescribed for poured joints, leaving a net uniform strip of filler material slightly below the surface of the pavement.

In case the filler material in an expansion joint is tilted or otherwise displaced by the strike-off or finishing machines, the filler and the accompanying dowel bar assembly shall be removed from the pavement and a complete new joint constructed at the same location.

**(b) Expansion Joints at Structures.** Expansion joints shall be formed at all existing or proposed structures and features projecting through, into or against the pavement and, unless otherwise indicated, such joints shall be three-fourths ( $\frac{3}{4}$ ) inch in thickness, for the full depth of the pavement, and shall be the preformed type and shall conform to A.A.S.H.O. Designation M-153.

**(c) Transverse Construction Joints.** Unless other prescribed joints occur at the same points, transverse construction joints conforming to details on the plans, shall be made at the end of each day's run or where interruption in the concrete operations of more than thirty (30) minutes occurs.



An "installing bar" as prescribed for transverse expansion joints shall be used or a clean plank having a thickness of not more than three (3) inches and cut to conform with the typical cross sections of the slab with a beveled strip to form a keyway joint may be used as a header board. The installing bar shall be carefully removed and any surplus concrete on the subgrade shall be cleaned away and the fresh concrete deposited directly against the old.

**(d) Transverse Contraction Joints.** Contraction joints shall be of the type and spacing shown on the plans, shall be constructed at right angles to the centerline and perpendicular to the surface of the pavement.

Sawed contraction joints shall be cut by means of an approved concrete saw. The joints shall not be sawed until the concrete has hardened to the extent that tearing and ravelling is precluded. Part or all of the joints shall be sawed before the pavement starts shrinking and before uncontrolled cracking takes place. The spacing of the joints that must be sawed early will depend on several factors but shall be at such intervals that will prevent uncontrolled cracking. Any procedure which results in premature and uncontrolled cracking shall be revised immediately by adjusting the sequence of cutting the joints or the time interval involved between the placing of the concrete or the removal of the curing media and the cutting of the joints. In no case shall the pavement be left uncovered overnight without having the joints sawed.

The joints shall be sawed at the depth, spacing and lines shown on the plans. If there are gutters and curbs they shall be cut to the proper depth to prevent erratic cracking. Suitable device or guide lines shall be provided to insure cutting the joint in a straight line and perpendicular to the centerline of the pavement.

All contraction joints in adjacent widths of multiple lanes shall be sawed before uncontrolled cracking occurs. Any procedure which results in premature and uncontrolled cracking shall be revised immediately.

Immediately after the sawing operation is completed the groove shall be flushed out with water under pressure, and then cleaned, with compressed air, of all dust, water and slurry. The groove shall be cleaned again with a strong jet of compressed air just prior to filling the groove with joint filler.

**(e) Longitudinal Joints.** Longitudinal joints shall be constructed as shown on the plans and all such joints, not made by a form, shall be sawed true to line and perpendicular to the surface of the pavement. Sawing shall conform to the requirements specified for "Transverse Contraction Joints."

**(f) Keyway Longitudinal Joints.** Keyway joints shall be used at the locations shown on the plans where one longitudinal lane of pavement is to be constructed against another separately laid lane of pavement. The keyway joint shall be a tongue and groove joint, the tongue and groove to be of the dimensions shown on the plans. The edges of the slabs abutting the joint shall be tooled to one-eighth ( $\frac{1}{8}$ ) inch radius.



Construction of the second abutting lane at the keyway joint will not be permitted until the concrete in the first lane has attained a flexural strength of at least six-hundred (600) lbs. per square inch (A.A.S.H.O. Designation T-97) or a compressive strength (A.A.S.H.O. Designation T-22) of at least four-thousand (4,000) lbs per square inch.

**.04 (12) Consolidating and Finishing.** The sequence of operations shall be:

First "the strike off and consolidation."

Second—"longitudinal floating and removal of laitance"

Third—"straightedging"

Fourth—"belting and burlap drag final finish"

The machine method of strike-off and consolidation may be employed except that, for areas where the width of slab changes, hand methods will be allowed. All finishing equipment and tools shall be thoroughly clean prior to use and shall be so maintained during their period of use on the work.

**(a) Strike-off and Consolidation.** The concrete, as soon as placed, shall be accurately struck-off and screeded, with approved machine equipment, to the crown and cross-section shown on the plans and to such elevation slightly above grade that when properly consolidated and finished the surface of the pavement shall be at the exact grade elevation indicated by the plans.

The machine equipment shall be of the screeding and troweling type, equipped with two independently operated screeds, to strike-off and consolidate the concrete and shall be subject to the approval of the engineer. The machine shall go over each area of pavement as directed and as many times and at such intervals as is necessary to give the proper compaction and to leave a surface of uniform texture, true to grade and crown. Prolonged operation over a given area shall be avoided. The tops of the forms shall be kept clean by an effective device attached to the machine and the travel of the machine on the forms shall be maintained true without lift, wobbling, or other variation tending to affect the precision finish. The finishing machine shall be of ample strength to withstand severe use and shall be fully and accurately adjustable for loss of crown or other derangement due to wear. At least two (2) trips of the finisher will be required over all pavement areas.

During the first pass of the finishing machine, a uniform ridge of concrete shall be maintained ahead of the front screed for its entire length. Except when making a construction joint, the finishing machine shall not be operated beyond that point where the above described surplus can be maintained ahead of the front screed.

(b) **Longitudinal Floating.** In this operation, a self-powered mechanical longitudinal float, riding on the side forms, shall be used. It shall be of a type which works with a sawing motion while held in "floating position" parallel to the road centerline and passed gradually from one side of the pavement to the other. Movements ahead along the centerline of the road shall be in successive advances not more than one-half ( $\frac{1}{2}$ ) of the length of the float. Its design and manufacture shall be of a type and style which in operation will provide a smooth true section. All mechanical floats or other type of equipment proposed for use in this operation must be approved by the engineer prior to use.

(c) **Straightedge Finishing.** After the longitudinal floating is completed, but while the concrete is still plastic, minor irregularities and score marks remaining in the pavement surface shall be eliminated by means of longhandled wood floats and straightedges. When necessary, excess water and laitance shall be removed from the surface transversely by means of a finishing straightedge. The long-handled floats may be used to smooth and fill in open-textured areas in the pavement surface, but the final finish shall be made with the straightedge. The use of long-handled floats shall be held to a minimum as necessary to correct local surface unevenness not taken care of by the longitudinal float, but it shall not be used to float the entire pavement surface. Straightedges shall be not less than ten (10) feet in length and may be operated from bridges and from the side of the pavement. A straightedge operated from the side of the pavement shall be equipped with a handle three (3) feet longer than one-half ( $\frac{1}{2}$ ) the width of the pavement. The surface shall be tested for trueness with a straightedge not less than ten (10) feet in length, which shall be held in successive positions parallel and at right angles to the centerline of the pavement in contact with the surface and the whole area covered as necessary to detect variations. The straightedge shall be advanced along the pavement in successive stages not more than one-half ( $\frac{1}{2}$ ) its length. Depressions shall be immediately filled with freshly mixed concrete, struck-off, consolidated, and refinished. Projections above the required elevation also shall be struck-off and refinished. The straightedge testing and finishing shall continue until the entire surface is free from observable departure from the straightedge, conforms to the required grade and contour and, when the concrete is hardened, will conform with the surface requirements specified under this Article, Paragraph (12) (k), surface test.

(d) **Belting.** When most of the water glaze or sheen has disappeared and before the concrete becomes non-plastic, the surface of the pavement, in short increments of length, shall be belted with a two-ply canvas belt, not less than eight (8) inches wide and at least two (2) feet longer than the width of the slab. Hand belts shall have suitable handles to permit controlled, uniform manipulation. The belt shall be operated with short strokes transverse to the paving strip and with

continuous advance longitudinally. Belts shall be cleaned as required. The belting shall be carefully done so as to produce a finished surface without leaving disfiguring marks. No tool marks of any kind shall be present in the finished surface.

**(e) Burlap Drag Finishing.** After belting, the surface of the pavement shall be dragged longitudinally in the direction of the concrete placement with a multiple ply burlap drag at least three (3) feet in width and equal in length to the width of the slab. The leading transverse edge of the drag shall be securely fastened to a traveling bridge, leaving at least one (1) foot of the burlap adjacent to the rear edge in contact with the pavement. The drag shall be operated with the burlap moist and shall be cleaned and changed as required. The dragging shall be carefully done so as to produce a finished surface having a fine granular or sandy texture without leaving disfiguring marks. The edges of the slab shall be finished, carefully and neatly, with an edging tool having a radius of one-fourth ( $\frac{1}{4}$ ) inch before the concrete has taken its initial set. The surface of pavement at joint edges shall be dragged as necessary with a small hand operated drag following edge tooling. No tool marks of any kind shall be present on the finished surface.

**(f) Hand Method, Consolidation.** The contractor shall provide the necessary equipment for hand finishing, both on normal sections and super-elevated sections so that hand equipment will be available for use in case the machine finishing equipment breaks down.

The concrete, as soon as placed, shall be struck-off and screeded to the crown and cross-section shown on the plans and to such elevation above grade that, when consolidated and finished, the surface of the pavement shall be at the exact grade elevation indicated by the plans.

The entire surface shall then be tamped and the tamping operation continued until the required compaction and reduction of surface voids is secured. A strike-off or tamping templet shall be provided on the work. It shall be durably constructed of three (3) or four (4) inch lumber, steel shod, or of a steel channel two (2) feet longer than the proposed width of pavement slab and sufficiently strong and rigid to retain its shape under all working conditions. In making the strike-off above mentioned, the templet shall be moved forward with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing and so manipulated that neither end is raised from the side forms during the strike-off process.

After the concrete has been consolidated, the surface shall be struck-off to the true section with a hand operated screed. This screed shall be mechanically vibrated at a rate not less than thirty-five hundred (3,500) vibrations per minute. The screed may be adjusted, or a separate screed shall be furnished, for each variation in crown section. This screed shall be operated forward with a combined longitudinal and trans-

verse motion, and shall be so manipulated that neither end will be raised off the side forms. Not less than two (2) screedings of the surface shall be made.

(g) **Hand Method, Finishing.** After the concrete has been placed, consolidated and struck-off as hereinbefore prescribed, the pavement shall be finished in the manner described as follows:

A longitudinal float, twelve (12) inches wide and twelve (12) feet long with edges of its bottom surface rounded, shall be equipped with plow handles of such length that the operators may stand upright while working from bridges.

The float shall be operated longitudinally over the entire surface of the pavement and with a combined longitudinal and transverse motion, passing slowly from one side of the pavement to the other, a sufficient number of times (at least twice) to smooth all ridges and fill all depressions, until the float on its last passage shall show contact with the concrete throughout its entire length and width. The float shall rest flat on the surface of the concrete throughout this operation except that if a ridge be encountered which cannot be eliminated by floating, the float may be tilted so that its edge will operate as a screed to remove the excess concrete, after which the surface shall be refloated with the float in the flat position. Depressions appearing after the initial passage of the float shall be filled with additional concrete before the final passage. The float shall be operated by men working on bridges that span the full width of pavement. In moving forward with the float each successive position shall overlap the preceding position by one-half ( $\frac{1}{2}$ ) of the length of the float.

(h) **Hand Method, Straightedge Finishing.** Straightedge finishing by hand methods shall be performed in accordance with the requirements specified for "Straightedge Finishing" in Paragraph (12) (c) of this Article.

(i) **Hand Method, Belting.** Belting by hand methods shall be performed in accordance with the requirements specified for "Belting" in Paragraph (12) (d) of this Article.

(j) **Hand Method, Final Finish, Burlap Drag.** The final finish with burlap drag shall be performed in accordance with the requirements specified for "Burlap Drag" in Paragraph (12) (e) of this Article.

(k) **Surface Test.** After the concrete has hardened, the surface of the pavement shall be tested with a ten (10) foot straightedge, operated parallel to the centerline of the pavement. During the test, each depression shall be successively spanned, each high spot touched by the testing edge, so as to reveal all irregularities. All portions of pavement showing a variation or departure from the testing edge of more than one-sixteenth ( $\frac{1}{16}$ ) inch per foot of distance, from the nearest point of contact with the testing edge or showing a total variation in excess of one-eighth ( $\frac{1}{8}$ ) inch from the ten (10) foot straightedge, shall be corrected by grinding



until the variations are within the above limits, provided, however, that where the methods used would result in an unsatisfactory surface, or where the grinding would result in a slab thickness less than specified or shown on the typical cross section, the affected portions of pavement shall be removed and replaced. All corrections of irregularities and removing and all replacing of pavement, shall be done at the contractor's expense. Any area or section to be removed and replaced shall be accomplished in accordance with "Deficient Thickness," as specified in Paragraph (5), Article 39.08.

**.04 (13) Protection and Curing. (a) Membrane.** After the concrete has been finally finished and the free water has left the surface, the entire area of the pavement surface shall be sealed, by hand or machine spraying, using a uniform application of curing compound, as specified in Paragraph (15), Article 39.02.

The solution shall be applied in one or two separate applications as may be recommended by the manufacturer and as directed by the engineer. If the solution is applied in two increments, the second application shall follow the first application within thirty (30) minutes.

The contractor shall provide satisfactory equipment and means to properly control and assure the direct application of the curing solution on the pavement surface so as to result in a uniform coverage in the pavement at the rate of one (1) gallon for each one-hundred-and-fifty (150) square feet of area.

Satisfactory equipment and means to control and apply the curing solution shall be construed as being whatever appliances and methods that are needed to prevent the loss of any of the solution during the application, together with an approved means of measuring the quantity to be applied and to insure complete and uniform coverage of the pavement.

If rain falls on the newly coated pavement before the film has dried sufficiently to resist damage, or if the film is damaged in any other way, the contractor will be required to apply a new coat of material to the affected portions equal in curing value to that above specified. All areas cut by finishing tools subsequent to the application of the curing solution shall immediately be given new applications at the specified rate above.

The contractor shall provide, on the job, sufficient burlap for the protection of the pavement in case of rain or breakdown of the spray equipment. In the event that hair checking develops before the curing compound can be applied, the procedure shall be modified in that initial curing with wet burlap, cotton mats or other material, approved by the engineer, shall be performed before the curing compound is placed.

**(b) Wet Burlap or Cotton Mats.** Preliminary curing may be accomplished by covering the entire surface of the pavement with blankets of wetted burlap, cotton fabric or other material of highly absorptive quality, previously approved



by the engineer, laid directly upon the finished surface as soon after final finishing as possible without marring the surface. The material shall be kept saturated in place for at least thirty (30) hours.

For completion of the curing, the mats used for the preliminary curing period may be left in place and kept saturated for ninety-six (96) hours or may be removed at the end of thirty (30) hours, the preliminary period, and immediately sealed with the curing compound specified in Paragraph (15) of Article 39.02.

**39.05 OPENING TO TRAFFIC.** Opening to traffic, including the contractor's vehicles, will not be permitted until the longitudinal joints have been completed and the flexural strength of the concrete, as indicated by the modulus of rupture of beams tested in conformity with A.A.S.H.O. Designation T-97, is at least six hundred (600) pounds per square inch, (or in compressive strength of 6"x12" cylinders, tested in conformity with A.A.S.H.O. Designation T-22, is at least four-thousand (4,000) pounds per square inch.)

If permanent shoulders are not in place, a temporary earth shoulder shall be placed against the outside pavement edges before traffic is allowed on the pavement.

Opening to all traffic shall not constitute a final acceptance of the pavement.

**39.06 INTEGRAL CURB.** Integral curb shall be the curb which is constructed monolithically with the pavement.

Outside forms for the integral curb shall have a height not less than the specified height of the curb and shall conform to the requirements specified in Paragraph (2), Article 39.04 and Paragraph (3) Article 39.03.

The inside face of the integral curb may be formed by approved steel forms held straight and rigid in place by steel clamps or space bars attached to the outside form.

The integral curb may be constructed by an alternate method, when approved by the engineer, which eliminates the use of an inside form. Sufficient additional concrete shall be placed against the outside form to construct the integral curb along with the concrete placed for the pavement. The inside face of the curb shall be formed by means of a special steel template or "mule" shaped to the dimensions and cross section shown on the plans. The top edge of the integral curb shall be rounded with an edger to form the radii shown on the plans.

The inside face of the curb shall be finished true to the lines and grades shown on the plans and the finish shall be the same as specified for the concrete pavement including longitudinal floating and burlap drag finishing. While the concrete is still plastic, the surface shall be tested for longitudinal trueness with a straightedge and the surface shall meet the same surface requirements as specified for the concrete pavement.

Joints in the concrete pavement shall be continued through the integral curb at the same locations and shall be the same type of joint and constructed in the same manner as required for the concrete pavement.

The integral curb shall be cured in accordance with the requirements specified for concrete pavement.

Integral curb shall not be measured and paid for separately, but shall be included with and considered a part of the price bid and paid for concrete pavement.

**39.07 WEATHER AND NIGHT LIMITATIONS.** Except by specific written authorization, concreting operations shall not be continued when a descending air temperature in the shade and away from artificial heat falls below 40 degrees F. nor resumed until an ascending air temperature in the shade and away from artificial heat reaches thirty-five (35) degrees F. In such cases the aggregates may be heated, either by steam or dry heat, prior to being placed in the mixer. The equipment used for heating the aggregates shall heat the mass uniformly and preclude the possible occurrence of overheated areas which might injure the materials. The temperature of the mixed concrete shall not be less than fifty (50) degrees F. or more than seventy (70) degrees F. at the time of placing it in the forms.

If the temperature during the ten (10) hours previous to the placing of the concrete has been thirty-two (32) degrees F. or less, the aggregates and water shall be heated to not less than seventy (70) degrees F. nor more than one-hundred (100) degrees F. Material containing frost or lumps of hardened material shall not be used. Neither salt nor chemical admixtures shall be added to the concrete to prevent freezing.

Concreting operations shall be discontinued when darkness would prevent good workmanship in placing and finishing operations. Night operations may be carried on upon specific approval of the engineer and when an adequate and approved artificial lighting system is provided and operated.

When concrete is being placed during cold weather and the air temperature may be expected to drop below thirty-five (35) degrees F. a sufficient supply of straw, hay, grass or other suitable blanketing material shall be provided along the line of the work and at any time when the air temperature may be expected to reach the freezing point during the day or night the material so provided shall be spread over the pavement to a sufficient depth to prevent freezing of the concrete before it has thoroughly hardened. The period of time over which such protection shall be maintained shall be not less than ten (10) days. If required by the engineer, concrete laid less than twenty-four (24) hours shall be covered by approved canvas or similar heating enclosures and devices capable of maintaining the temperature within the concrete at not less than fifty (50) degrees F. The contractor shall be responsible for the quality and strength of the concrete laid during cold weather and any concrete injured by frost action shall be removed and replaced at his expense.

**39.08 METHOD OF MEASUREMENT.** (1) Portland Cement concrete pavement shall be measured by area in square yards and the yardage to be paid for shall be the number of square yards of concrete pavement, including integral curb, completed and accepted, measured complete in place. The width for measurement will be the width from outside to outside of completed pavement, but not to exceed the width as shown on the plans or as ordered by the engineer. The length will be the actual length measured along the centerline of the pavement surface. Area constructed other than as pavement will be deducted from the area of pavement.

(2) Fillets, for widened sections or at drainage structures and similar locations placed monolithic with the pavement, will be measured for payment. No deduction will be made for any fixture located within the limits of the pavement when such fixture has a surface area, in the plane of the pavement surface, of nine (9) square feet or less.

(3) Pavement will be measured to the nearest one-tenth (1/10) square yard.

(4) It is the intent of these specifications that pavement shall be constructed strictly in accordance with the thickness shown on the plans. The thickness of the pavement shall be measured, and where any pavement is found not so constructed, such pavement may be compensated for at an adjusted unit price per square yard, or such pavement may be removed and replaced with satisfactory pavement.

(5) **Deficient Thickness.** If so ordered by the engineer, pavement thickness may be determined by at least two (2) cores taken from each one-thousand (1,000) linear feet of each lane and at such other locations as the engineer may direct.

Payment will not be made for slabs deficient in thickness by more than one-half ( $\frac{1}{2}$ ) inch.

If so ordered by the engineer, such slabs shall be removed and replaced at the expense of the contractor with concrete of required thickness which, when accepted, shall be included in the pay yardage. Deductions for deficiency in thickness are herewith tabulated:

Deficiency in Thickness	Proportional Part of Contract Price Allowed
$\frac{1}{8}$ in. to $\frac{1}{4}$ in.	90%
$\frac{1}{4}$ in. to $\frac{1}{2}$ in.	75%

In removing pavement that is deficient in thickness, the pavement shall be removed from the edge to a longitudinal joint, or between longitudinal joints and on each side of the deficient measurement until no portion of the exposed cross section is more than one-eighth ( $\frac{1}{8}$ ) inch deficient, except that

in no instance shall there be less than ten (10) linear feet of pavement removed. If, in meeting the above requirements, there remains less than five (5) feet of acceptable pavement between the section that has been removed and a transverse plane of weakness (contraction, expansion or construction joints), then the contractor shall remove the pavement to the plane of weakness. The contractor shall then replace with satisfactory pavement all of the pavement that has been removed. Deductions for deficient thickness may be entered on any estimate after the information becomes available.

(6) Material used as a "Foundation Course" for the concrete pavement shall be measured in accordance with the item as bid and with the provisions of the section pertaining to that material.

**39.09 BASIS OF PAYMENT.** The yardage of completed and accepted Portland Cement concrete pavement, measured as provided for above, with no additional compensation for any excess thickness, shall be paid for at the contract unit price per square yard, for "Concrete Pavement" with proper allowance made for any deductions for deficiency in thickness, which price shall be full compensation for furnishing, hauling, preparing, placing, finishing, curing and protecting, and for all materials, joints and joint materials, dowels, tie bars, and spacer bars, and for all integral curb and for preparing the subgrade and foundation course, and for all labor, equipment, tools and incidentals necessary for the proper construction of the pavement complete in place.

Material used as a "Foundation Course" shall be paid for as indicated in the proposal form and in accordance with the applicable section.

Item Number	Item Description	Unit
3906	Plain Portland Cement Concrete Pavement—6" Sq. Yd.	
3907	Plain Portland Cement Concrete Pavement—7" Sq. Yd.	
3908	Plain Portland Cement Concrete Pavement—8" Sq. Yd.	
3909	Plain Portland Cement Concrete Pavement—9" Sq. Yd.	
3910	Plain Portland Cement Concrete Pavement—10" Sq. Yd.	
3916	Reinf. Portland Cement Concrete Pavement—6" Sq. Yd.	
3917	Reinf. Portland Cement Concrete Pavement—7" Sq. Yd.	
3918	Reinf. Portland Cement Concrete Pavement—8" Sq. Yd.	
3919	Reinf. Portland Cement Concrete Pavement—9" Sq. Yd.	
3920	Reinf. Portland Cement Concrete Pavement—10" Sq. Yd.	



**SECTION 40**  
**REMOVAL OF STRUCTURES**  
**AND**  
**AND FACILITIES**





**40.01 DESCRIPTION.** "Removal of Existing Structures" shall consist of the removal and satisfactory disposal of all portions of existing structures, except such portions as may be required or permitted to be left in place by these specifications, the plans, or the special provisions, and also the maintenance of traffic and all other operations specified in this section. This subsection shall, generally, concern bridges and similar structures.

**40.02 REMOVAL OF SUPERSTRUCTURES.** Portions of steel or timber superstructures required to be salvaged shall be dismantled, handled and stored in such manner as to avoid any unnecessary damage to any member thereof. Any and all members, pins, nuts, plates, etc., which are damaged, cut or destroyed as a result of the contractor's operations, shall be repaired or replaced by the contractor at his sole expense. Concrete and masonry superstructures shall be removed and disposed of as provided herein unless otherwise specified.

All members shall be match-marked with paint before they are dismantled. All pins, nuts, plates, etc., shall be similarly marked to indicate their proper location; all pins, pin holes, and machined surfaces shall be painted with a mixture of white lead and tallow, and all loose parts shall be wired to adjacent members or packed in boxes with contents clearly marked thereon or index numbered for future identification.

**40.03 REMOVAL OF SUBSTRUCTURES.** Unless otherwise specified or ordered by the engineer, all portions of the substructures of existing structures above the bed of the stream, finished ground surface, or ground surface as it existed before the work was started, and all portions below the bed of the stream or ground surface which interfere in any way with the new construction, shall be removed. Blasting or other operations which might endanger the new work shall be completed prior to the construction of any part of the new structure.

Where piles compose the substructure, or a part thereof, the contractor shall cut off the piles one foot below the finished ground surface, or pull them, as he prefers. However, if they interfere with the new construction, he shall remove them completely.

The substructures for temporary bridges shall be removed as required herein for the substructures of existing structures.

**40.04 DISPOSAL OF MATERIALS REMOVED.** (a) **Structural Steel.** Structural steel members removed from the old structures shall, unless otherwise specified or directed, be stored in a neat and presentable manner in locations designated by the engineer, within the right-of-way and adjacent to the site of the work. Members of structures which are to be re-erected and all steel beams shall be stored above the ground surface on skids or otherwise protected as directed by the engineer.

**(b) Concrete and Masonry.** Concrete and masonry which is removed from old structures shall, as far as practicable, be placed in backfills or approach embankments or shall be used to riprap the slopes of the embankments or the channel if specified on the plans. Any concrete or masonry which cannot be placed in backfills or embankments or used as riprap shall be disposed of as directed by the engineer and in such manner as to prevent damage to property or the creation of unsightly conditions.

**(c) Timber and Other Materials.** All timber and other materials having salvage value shall be piled up in a neat and presentable manner on skids above ground in locations designated by the engineer, within the right-of-way and adjacent to the site of the work.

**(d) Ownership of Materials Removed.** All materials having salvage value shall be disposed of as provided herein and shall be considered the property of the State. Written permission to use any of these materials in the contractor's operations shall be secured from the engineer.

**40.05 DISPOSAL OF TEMPORARY STRUCTURES, CLEANING SITES, ETC.** Upon the completion of the new structures, with the necessary backfilling and roadway embankments, the contractor shall remove and dispose of any temporary structure he may have installed in connection with the maintenance of traffic, to the satisfaction of the engineer; and furthermore, he shall leave the adjacent premises in such condition as to present neat and acceptable appearances.

**40.06 BASIS OF PAYMENT.** If the contract contains a separate item and price for "Removing Existing Structures and Maintaining Traffic," such price shall be payment in full for the removal and disposal of the existing structures, maintenance of traffic, and all other operations specified in this section.

If the contract does not contain a separate item and price for "Removing Existing Structures and Maintaining Traffic," payment in full for the work specified in this section shall be considered as included in the contract unit prices for the various items of the contract.

Item Number	Item Description	Unit
4001	Removal of Existing Structure	Lump Sum
4002	Maintaining Traffic	Lump Sum
4003	Removal of Existing Structures and Maintaining Traffic	Lump Sum

**SUBSECTION 40.20 REMOVAL OF MISCELLANEOUS FACILITIES****40.21 DESCRIPTION.** "Removal of Miscellaneous Facilities"

shall consist of the removal and disposal of miscellaneous existing facilities which are listed in the proposal, such as curb, gutter, curb and gutter, fireplug, manhole, inlet, sidewalk, driveway, headwall, box culvert, sign, etc., in accordance with this specification, the plans and special provisions. This subsection will not pertain to any such facilities that will be reset or reinstalled under the contract.

**40.22 REMOVAL OF FACILITY.** The facility will be removed from the highway or area of construction in as neat and workmanlike manner as is practicable. Any and all facilities, belonging to a person or persons, that can be or are to be used and/or reinstalled elsewhere shall be removed carefully and without damage, if possible, and placed where directed by the engineer. Facilities that must be wrecked or damaged in removal shall be disposed of in a place away from the project and the contractor shall be responsible for such disposition.

If and when these specifications are inadequate, under the circumstances, a special provision will be prepared and shall apply.

**40.23 METHOD OF MEASUREMENT.** Measurement shall be as indicated in the bid tabulation; by the item number, or as prescribed by the special provisions.

**40.24 BASIS OF PAYMENT.** When the contract contains a separate item and price for removal of facilities, listed in the proposal, such price shall be full payment for the removal and disposal of such existing facilities, including labor, material, incidentals and other costs.

Item Number	Item Description	Unit
4020	Remove Concrete Curb	Lineal Foot
4021	Remove Concrete Curb and Gutter	Lineal Foot
4022	Remove Concrete Gutter	Lineal Foot
4023	Remove Concrete Sidewalk	Square Yard
4024	Remove Concrete Pavement	Square Yard
4025	Remove Concrete Structure	Lineal Foot
4026	Remove Concrete Structure	Square Yard
4027	Remove.....Signs	Each
4028	Remove Fire Hydrant	Each
4029	Remove Manhole	Each
4030	Remove Inlet	Each
4031	Remove Headwall	Each
4032	Remove Barbed Wire Fence	Rod
4033	Remove Woven Wire Fence	Rod



**SECTION 41**

**CONCRETE BRIDGES**



**41.01 DESCRIPTION.** Work and materials under this section shall consist of concrete bridges and the concrete portions of steel, timber and composite bridges, constructed in conformity with the plans or as ordered in writing by the engineer, and in accordance with this and other specification items involved.

**41.02 MATERIALS.** All materials used shall be those prescribed for the several items which constitute the structure.

**41.03 METHOD OF CONSTRUCTION. (a) Foundations.** All foundations shall be prepared as specified under Section 45 "Excavation for Structures" and they shall be inspected and approved by the engineer previous to placing any concrete.

**(b) Drains.** Drains and waterstops shall be constructed as shown on plans or as directed by the engineer.

**(c) Placing Concrete.** Concrete shall be placed in accordance with the requirements specified under Subsection 46.00, "Portland Cement Concrete."

**(d) Falsework and centering.** Unless otherwise provided, detailed plans for falsework or centering shall be supplied to the engineer upon request, but in no case shall the contractor be relieved of responsibility for results obtained by the use of these plans.

Arch centering shall be constructed according to centering plans approved by the engineer. Provision shall be made by means of suitable wedges or jacks for the gradual adjustment and release of falsework or centering supports. Supplemental sand boxes or other approved devices may be used for lowering arch centering.

No falsework or centering supports shall be removed unless removal meets with approval of the engineer. In general, falsework or centers shall be struck before coping or railing forms are erected. This precaution is essential in multiple spans to avoid joining of expansion joints and to provide for variations in alignment and camber. For filled spandrel arches, such portions of the spandrel walls shall be left for construction subsequent to the striking of centers as may be necessary to avoid jamming of the expansion joints.

Falsework or centers shall be gradually and uniformly lowered in such a manner as to avoid stresses in any part of the structure. In structures of two or more spans, the sequence of striking falsework or centers shall be specified or approved by the engineer.

**41.04 METHOD OF MEASUREMENT.** The quantities of the various items which constitute the completed and accepted structure shall be measured for payment according to the plans and specifications for the several items. Only accepted work will be included and the dimensions used will be those shown on the plans or ordered in writing by the engineer.



**41.05 BASIS OF PAYMENT.** The measured quantities as provided above shall be paid for at the contract unit prices bid for the several items, which prices shall be full compensation for furnishing, hauling, and placing all materials, and for labor, equipment, tools, drains, water stops and necessary incidentals. Such payment shall constitute full compensation for the completed structure, ready for use, and no additional allowance will be made for cofferdam construction, falsework, form lumber, or other erection expenses unless otherwise set forth on the plans or in the special provisions.

Item Number	Item Description	Unit
4110	Floor Drain	Each
4120	Precast Prestressed Concrete Beam—35 ft.	Each
4121	Precast Prestressed Concrete Beam—40 ft.	Each
4122	Precast Prestressed Concrete Beam—45 ft.	Each
4123	Precast Prestressed Concrete Beam—50 ft.	Each
4124	Precast Prestressed Concrete Beam—55 ft.	Each
4125	Precast Prestressed Concrete Beam—60 ft.	Each
4126	Precast Prestressed Concrete Beam—65 ft.	Each
4127	Precast Prestressed Concrete Beam—70 ft.	Each
4128	Precast Prestressed Concrete Beam—75 ft.	Each
4129	Precast Prestressed Concrete Beam—80 ft.	Each
4150	Revision of Existing Concrete Bridge	Lump Sum





**SECTION 42**

**STEEL BRIDGES**



**42.01 DESCRIPTION.** Work and materials under this section shall consist of steel bridges, including but not limited to superstructures to be placed on concrete, masonry, steel or timber substructures, constructed in conformity with the plans or as ordered in writing by the engineer, and in accordance with this and other specification items involved.

**42.02 MATERIALS.** All materials used shall be those prescribed for the several items which constitute the structure.

**42.03 FOUNDATIONS.** All excavation for foundations and substructures shall be performed as specified under Section 45, "Excavation for Structures."

**42.04 PLACING CONCRETE.** All concrete shall be placed and finished as specified under Subsection 46.00, "Portland Cement Concrete."

**42.05 FABRICATION.** Structural steel shall be fabricated in accordance with the following requirements:

(1) **Drawings.** The construction plans shall consist of shop details, erection and other working plans showing details, dimensions, size of material and other information and data necessary for the complete fabrication and erection of the metal work. Approval of construction plans by the engineer shall be secured before fabrication of steel work is commenced. The contractor shall furnish the engineer with prints of the shop drawings, in quadruplicate, for approval, and after approval he shall furnish three or more prints, as required, of the approved drawings. All shop drawings shall be 22"x36" with a 1½" margin on the left side and a ½" margin on the other three sides. Upon completion of the work the original tracings, if required, shall be supplied to the engineer. No deviation from the approved plans shall be permitted without a written order from the engineer. Changes on approved drawings shall be subject to the approval of the engineer, and he shall be supplied with a record of such changes. Substitution of sections different from those shown on the drawings shall be made only when approved in writing by the engineer.

(2) **Workmanship and Finish.** The workmanship and finish shall be equal to the best practice in modern bridge shops. Shearing, flame cutting and chipping shall be neatly and accurately done and all portions of the work exposed to view shall be neatly finished.

(3) **Storage of Materials.** Structural material, either plain or fabricated, shall be stored at the bridge site above the ground upon platforms, skids, or other supports. It shall be kept free from dirt, grease or other foreign matter, and shall be protected as far as practicable from corrosion.

(4) **Straightening Materials.** Rolled material before being laid out or worked must be straight. If straightening is necessary, it shall be done by methods that will not injure the metal. Sharp kinks and bends may be cause for rejection of the material.

**(5) Punched Work.** If general reaming is not required, all material, forming parts of a member composed of not more than five thicknesses of metal, may be punched  $1/16$  inch larger than the nominal diameter of the rivets whenever the thickness of the metal is not greater than  $3/4$  inch for carbon steel or  $5/8$  inch for alloy steel.

When there are more than five thicknesses or when any of the main material is thicker than  $3/4$  inch in carbon steel, or  $5/8$  inch in alloy steel, all the holes shall be subpunched or subdrilled  $3/16$  inch smaller and, after assembling, reamed  $1/16$  inch larger, or drilled from the solid to  $1/16$  inch larger, than the nominal diameter of the rivets.

**(6) Punched Holes.** Holes punched full-size shall be  $1/16''$  larger than the nominal diameter of the rivet. The diameter of the die shall not exceed the diameter of the punch by more than  $1/16$  inch. If any holes must be enlarged to admit the rivets, they shall be reamed. Holes must be clean cut, without torn or ragged edges. Poor matching of holes will be cause for rejection.

**(7) Accuracy of Punched and Subdrilled Holes.** All holes punched full-size, subpunched, or subdrilled shall be so accurately punched that after assembling (before any reaming is done) a cylindrical pin  $1/8$  inch smaller in diameter than the nominal size of the punched hole may be entered perpendicular to the face of the member, without drifting, in at least 75 percent of the contiguous holes in the same plane. If the requirement is not fulfilled, the badly punched pieces will be rejected. If any hole will not pass a pin  $3/16$  inch smaller in diameter than the nominal size of the punched hole, this will be cause for rejection.

**(8) Reamed or Drilled Holes.** Reamed holes shall be cylindrical, perpendicular to the member and not more than  $1/16$  inch larger than the nominal diameter of the rivets. Where practicable, reamers shall be directed by mechanical means. Drilled holes shall be  $1/16$  inch larger than the nominal diameter of the rivet. Burrs on the outside surfaces shall be removed. Poor matching of holes will be cause for rejection. Reaming and drilling shall be done with twist drills. If required by the engineer, assembled parts shall be taken apart for removal of burrs caused by drilling. Connecting parts requiring reamed or drilled holes shall be assembled and securely held while being reamed or drilled and shall be match-marked before disassembling.

**(9) Subpunching, Reaming and Shop Assembly.** Unless otherwise specified, holes in all field connections and field splices of main truss or arch members, continuous beams, plate girders and rigid frames shall be subpunched (or subdrilled if subdrilling is required), and reamed while assembled in the shop. The assembly, including camber, alignment, accuracy of holes and milled joints, shall be approved by the engineer before reaming is commenced. Unless otherwise authorized by the engineer, each individual (full length)



truss, arch, continuous beam or girder shall be assembled in the shop before reaming is commenced. All holes for floor beam and stringer field end connections shall be subpunched and reamed to a steel template or reamed while assembled. If additional subpunching and reaming is required, it shall be specified in the special provisions or on the plans.

**(10) Accuracy of Reamed and Drilled Holes.** When holes are reamed or drilled, 85 percent of the holes in any contiguous group shall, after reaming or drilling, show no offset greater than  $1/32$  inch between adjacent thickness of metal.

**(11) Shop Assembling.** Shop assembly of trusses, arches, continuous beam spans and plate girders shall be according to Paragraph (9) above.

Complete shop assembly of an entire structure, including floor systems, which may be necessary in the case of complicated designs shall be done when shown on the plans or when stipulated in the special provisions. Surfaces of metal in contact shall be cleaned before assembling. The parts of a member shall be assembled, well pinned, and firmly drawn together with bolts before reaming or riveting is commenced. Assembled pieces shall be taken apart, if necessary, for the removal of burrs and shavings produced by the reaming operation. The member shall be free from twists, bends, and other deformation. Preparatory to the shop riveting of full-sized punched material, the rivet holes, if necessary, shall be spear-reamed for the admission of the rivets. The reamed holes shall not be more than  $1/16$  inch larger than the nominal diameter of the rivets. End connection angles, stiffener angles, and similar parts shall be carefully adjusted to correct positions and bolted, clamped, or otherwise firmly held in place until riveted. Parts not completely riveted in the shop shall be secured by bolts insofar as practicable, to prevent damage in shipment and handling.

**(12) Camber Diagram.** A camber diagram shall be furnished the engineer, showing the camber at each panel point for each truss, taken from actual measurements while the truss is assembled.

**(13) Drifting of Holes.** The drifting done during assembling shall be only such as to bring the parts into position, and not sufficient to enlarge the holes or distort the metal. If any holes must be enlarged to admit the rivets, they shall be reamed.

**(14) Match-Marking.** Connecting parts assembled in the shop for the purpose of reaming holes in field connections shall be match-marked, and a diagram showing such marks shall be furnished to the engineer.

**(15) Rivets.** The size of rivets called for on the plans shall be the size before heating. Rivet heads shall be of standard shape, unless otherwise specified, and of uniform size for the same diameter of rivet. They shall be full, neatly made, concentric with the rivet holes, and in full contact with the surface of the member.

**(16) Field Rivets.** Field rivets shall be furnished in excess of the nominal number required to the amount of 10 percent plus 10 rivets for each diameter and length.

**(17) Bolts and Bolted Connections. (a) General.** Bolted connections shall not be used unless shown on the plans. Where bolted connections are permitted, the bolts furnished shall be unfinished bolts (ordinary rough or machine bolts) unless otherwise specified. Turned bolts shall be provided where shown on the plans, or if required by the special provisions. Special ribbed drive fit bolts may be substituted for turned bolts upon written approval of the engineer. Bolted connections fabricated with high tensile strength bolts shall conform to Paragraph (18) below.

The holes shall be truly cylindrical. The size of holes shall be  $1/16$  inch greater than the nominal diameter of the bolts and shall make a driving fit with the bolts. Holes shall be at right angles to the surface of the metal so that both head and nut will bear squarely against the metal. Bolts shall be driven accurately into the holes without damaging the thread. A snap shall be used to prevent damaging the heads.

The heads and nuts shall be drawn tight against the work with a suitable wrench not less than 15 inches long. Bolt heads shall be tapped with a hammer while nut is being tightened. Where bolts are to be used in beveled surfaces, beveled washers shall be provided to give full bearing to the head or nut. All bolts shall have cut threads neatly and accurately finished. The nuts of unfinished, turned bolts and ribbed bolts shall be effectually locked after they have been finally tightened.

**(b) Unfinished Bolts.** Unfinished bolts shall be standard bolts with hexagonal heads and nuts. The diameter of the bolt holes shall be  $1/16$  inch greater than the diameter of the bolts used. Bolts transmitting shear shall be threaded to such a length that not more than one thread will be within the grip of the metal. The bolts shall be of such length that they will extend entirely through their nuts, but not more than  $1/4$  inch beyond them. The number of bolts furnished shall be 5 percent more than the actual number shown on the plans for each size and length.

**(c) Turned Bolts.** Holes for turned bolts shall be carefully reamed and the bolts turned to a driving fit with the threads entirely outside of the holes and a washer shall be used. The heads and nuts shall be hexagonal. One-fourth inch ( $1/4$ " ) nut locks shall be used on all turned bolts unless otherwise specified on the plans. Turned bolts shall be finished by a finishing cut.

**(d) Special Ribbed Bolts.** Ribbed bolts, with a drive fit, shall be used only where called for on the plans or approved in writing by the engineer. Ribbed bolts may be substituted for field rivets in locations where, in the opinion of the engineer, it is impractical to drive rivets. Ribbed bolts shall be furnished in the same number and in nominal sizes not smaller

than the rivets for which they are substituted. They shall be furnished in sufficient variety of lengths that when drawn tight the fluted shank will fill the hole in the work and the thread will completely fill the nut with not more than one thread protruding. If for any reason the bolts twist before drawing tight, the holes shall be carefully reamed and the bolt replaced with a new bolt of diameter to fit properly in the hole. The contractor shall provide and supply himself, at his sole expense, with oversize bolts for this replacement in an amount not less than 10 percent of the number of ribbed bolts specified.

**(18) Connections Using High Tensile Strength Bolts. (a) General.** When specifically authorized by the engineer, or when shown on the plans, high tensile strength bolts and nuts with hardened washers may be used for the assembling of structural connections where the initial tension in the bolt produces friction on the contact surfaces of the connected pieces sufficient in magnitude to resist shear. Except as otherwise provided in this paragraph, construction shall conform to applicable specifications for riveted structures. Bolts, nuts and washers shall conform to requirements of the current specifications for quenched and tempered steel bolts and studs with suitable nuts and plain washers (ASTM Designation A 325). Bolts manufactured to this specification are identified by markings on the top of the head with three radial lines.

Bolt dimensions shall conform to the current requirements for regular semifinished hexagon bolts (ASA Designation B 18.2).

Nut dimensions shall conform to the current requirements for heavy semifinished hexagon nuts (ASA Designation B 18.2).

Washer dimensions shall not be less than would conform to the current requirements of ASA Designation B 27.2.

**(b) Dimensions of Bolts, Nuts and Washers.** Bolt lengths shall be determined by adding the values given in Table I to the total thickness of connected material. The values in Table I compensate for thickness of nut, two flat washers, and bolt point. The total length shall be adjusted to the next 1/4 inch increment up to 5 inch length and to the next longer 1/2 inch increment for lengths over 5 inches.

**TABLE I—BOLT LENGTHS**

Bolt Size (Inch)	Add to Grip (Inch)
1/2	1
5/8	1 1/8
3/4	1 1/4
7/8	1 1/2
1	1 5/8
1 1/8	1 3/4
1 1/4	1 7/8

If other than the standard thickness of circular washer as given in Table II is used, the necessary bolt length shall be adjusted accordingly. Where beveled washers of the dimensions given in Table II are used, an additional  $\frac{1}{8}$  inch shall be added for each such beveled washer.

**TABLE II—WASHER DIMENSIONS**

Circular Washers				Square Beveled Washers for American Standard Beams and Channels		
Bolt Size (Inch)	Inside Diameter (Inch)	Outside Diameter (Inch)	Thickness Gage (Number)	Width	Mean Thickness	Slope
$\frac{1}{2}$	9/16	$1\frac{3}{8}$	12	$1\frac{3}{4}$	5/16	1:6
$\frac{5}{8}$	11/16	$1\frac{3}{4}$	10	$1\frac{3}{4}$	5/16	1:6
$\frac{3}{4}$	13/16	2	9	$1\frac{3}{4}$	5/16	1:6
$\frac{7}{8}$	15/16	$2\frac{1}{4}$	8	$1\frac{3}{4}$	5/16	1:6
1	1-1/16	$2\frac{1}{2}$	8	$1\frac{3}{4}$	5/16	1:6
$1\frac{1}{8}$	1-1/4	$2\frac{3}{4}$	8	$2\frac{1}{4}$	5/16	1:6
$1\frac{1}{4}$	1-3/8	3	8	$2\frac{1}{4}$	5/16	1:6

Circular washers shall be flat and smooth and their dimensions shall be not less than would conform to the current requirements of the American Standards Association (ASA Designation B 27.2) as given in Table II. Where clearance is necessary, washers may be clipped on one side to a point not closer than  $\frac{7}{8}$  of the bolt diameter from the center of the washer. Where bearing faces of the bolted parts have a slope of more than 1:20 with respect to a plane normal to the bolt axis, smooth beveled washers shall be used to compensate for lack of parallelism.

(c) **Bolted Parts and Assembly.** Holes may be punched, subpunched and reamed or drilled, as required by the applicable specification for riveted construction, and shall be of a diameter not more than  $\frac{1}{16}$  inch in excess of the nominal bolt diameter. Bolted parts shall fit solidly together when assembled. Contact surfaces including those adjacent to the washers, shall be descaled or carry the normal tight mill scale. Contact surfaces shall be free from dirt, oil, loose scale, burrs, pits and other defects that would prevent solid seating of the parts. Contact surfaces of joints shall be free of paint or lacquer unless otherwise indicated by the plans or special provisions. Connections shall be assembled with a hardened washer under the bolt head and nut. Surfaces of bolted parts in contact with the bolt head and nut shall be parallel, except flat washers may be used on surfaces having a slope not greater than 1:20 with respect to a plane normal to the bolt axes, provided the nut is torqued against a non-sloping surface. For slopes greater than 1:20, smooth beveled washers shall be used to produce parallelism.



All nuts shall be tightened to give at least the required minimum bolt tension values given in Table III upon completion of the joint.

**TABLE III—BOLT TENSION AND TORQUE VALUES**

Bolt Size (Inch)	Recommended* Bolt Tension For Calibrating Wrenches (Pound)	Required** Minimum Bolt Tension (Pound)	Approximate*** Equivalent Torque For Required Minimum Bolt Tension (lb. ft.)
1/2	12,500	10,850	90
5/8	20,000	17,250	180
3/4	29,000	25,600	320
7/8	37,000	32,400	470
1	49,000	42,500	710
1 1/8	58,000	50,800	960
1 1/4	74,000	64,500	1,350

Note 1—Wrenches should be set to induce a bolt tension in excess of the required minimum bolt tension as given in Table III. Because of the varying relation between torque and induced tension, it is suggested that wrenches be set to induce the recommended bolt tension for calibrating wrenches as given in Table III.

Note 2—In using a power wrench, the recommendations of the wrench manufacturer should be consulted in its operation and care should be taken that the machine is maintained in proper working condition and proper calibration.

Note 3—In using a manual torque wrench, the required torque can be read from the wrench dial, or in other types of wrenches, the torque may be indicated by a release of the wrench. Care should be taken that the wrench is properly calibrated. Nuts shall be in motion when torque is measured.

Note 4—In using manual plain wrenches, a ratchet wrench of length consistent with the man-effort available should be used so that the product of the effective wrench length in feet times the man-effort in pounds exceeds the equivalent torque required.

\* Approximately 15 percent in excess of the required minimum bolt tension.

\*\* Equal to 90 percent of the minimum proof load of bolt (ASTM A325.) There is no recommended maximum bolt tension.

\*\*\* Equal to 0.0167 lb. per in. bolt diameter per lb. tension for non-lubricated bolts and nuts. Values given are experimental approximations. If torque rather than tension is to be measured, the torque-tension ratio shall be determined by the actual conditions of the application.



**(d) Inspection.** The inspector shall satisfy himself that all requirements of this specification are met. The inspector shall approve the procedure for calibration of wrenches and installation of bolts. The inspector shall further observe the field installation to determine that these procedures are followed. The proper execution of the bolting operation may be checked and approved by a procedure of loosening and retightening 10 percent of the nuts of each group of bolts. This procedure shall be such as to establish that, when the nut is retorqued to its original position, the torque is at least equal to that required by the above provisions.

**(19) Riveting.** Rivets shall be heated uniformly to a "light cherry red color" and shall be driven while hot. Any rivet whose point is heated more than the remainder shall not be driven. When a rivet is ready for driving, it shall be free from slag, scale and other adhering matter. Any rivet which, in the opinion of the engineer, is scaled excessively will be rejected. All rivets that are loose, burned, badly formed, or otherwise defective shall be removed and replaced with satisfactory rivets. Any rivet whose head is defective in size or whose head is driven off center will be considered defective and shall be removed. Stitch rivets that are loosened by driving of adjacent rivets shall be removed and replaced with satisfactory rivets. Caulking, recupping or double gunning of rivet heads will not be permitted.

Shop rivets shall be driven by direct-acting rivet machines when practicable. Approved beveled rivet sets shall be used for forming rivet heads on sloping surfaces. When the use of a direct-acting rivet machine is not practicable, pneumatic hammers of approved size shall be used. Pneumatic bucking tools will be required when, in the opinion of the engineer, the size and length of the rivets warrant their use. Rivets may be driven cold provided their diameter is not over  $\frac{3}{8}$  inch.

**(20) Edge Planing.** Sheared edges of plates more than  $\frac{5}{8}$  inch in thickness and carrying calculated stress shall be planed to a depth of  $\frac{1}{4}$  inch re-entrant cuts shall be filleted before cutting.

**(21) Welds.** All welding shall conform to specifications for welded highway and railway bridges of the American Welding Society, with subsequent amendments and additions thereto adopted by the society.

If a fabricating shop prequalifies its metal-arc welding operators according to the standard qualification procedure of the American Welding Society and certifies to the engineer that an operator working on the structure has been prequalified within twelve months previous to the beginning of work on the subject structure, the engineer may consider such operator qualified. The certificate shall state that such operator has been doing satisfactory welding of the required type within the three month period previous to the subject work. A certification shall be submitted for each operator and for each project, stating the name of the operator, the name and

title of the person who conducted the examination, the kind of specimens, the positions of welds, the results of the tests and the date of the examination. Such a certification of pre-qualification may also be accepted as proof that an operator on field welding is qualified, if the contractor who submits it is properly staffed and equipped to conduct such an examination or if the examining and testing is done by a recognized agency which is staffed and equipped for such purpose.

**(22) Flame Cutting.** Steel or wrought-iron may be flame cut, provided a smooth surface is secured by the use of a mechanical guide. Flame cutting by hand shall be done only where approved by the engineer and the surface shall be made smooth by planing, chipping or grinding. The cutting flame shall be so adjusted and manipulated as to avoid cutting beyond the prescribed lines. Re-entrant cuts shall be filleted to a radius of not less than 1/2 inch.

In the case of silicon steel, flame cut edges shall be removed to a depth of at least 1/4 inch by milling, chipping or grinding, except that machine flame-cut edges may be used without such removal if the edges are softened after cutting; (a) by heating the cut edge uniformly and progressively to a red heat, visible in ordinary shop light (1,150° to 1,250° F.) to a depth of at least 1/16 inch; or (b) by means of a post-heating torch attached to and following the cutting torch; the tips, gas pressure, speed of travel and the distance of postheating torch from kerf regulated to the thickness of the steel. Bend test specimens so cut and flame softened shall meet the bend test requirements for that thickness in specifications A.S.T.M. A94-46.

**(23) Facing of Bearing Surfaces.** The surface finish of bearing and base plates and other bearing surfaces that are to come in contact with each other or with concrete shall meet the American Standard Association surface roughness requirements as defined in A.S.A. B46.1-47, surface roughness, waviness and lay, Part I:

Steel slabs .....	ASA 2,000
Heavy plates in contact in shoes to be welded.....	ASA 1,000
Milled ends of compression members, stiffeners, and fillers .....	ASA 500
Bridge rollers and rockers.....	ASA 250
Pins and pin holes.....	ASA 125
Sliding bearings .....	ASA 125

**(24) Abutting Joints.** Abutting joints in compression members and girder flanges, and in tension members where so specified on the drawings, shall be faced and brought to an even bearing. Where joints are not faced, the opening shall not exceed 1/4 inch.

**(25) End Connection Angles.** Floor beams, stringers and girders having end connection angles shall be built to exact length back to back of connection angles. If end connections are faced, the finished thickness of the angles shall not be less than that shown on the detail drawings.

(26) **Lacing Bars.** The ends of lacing bars shall be neatly rounded unless another form is required.

(27) **Finished Members.** Finished members shall be true to line and free from twists, bends and open joints.

(28) **Web Plates.** In girders having no cover plates and not to be encased in concrete, the top edge of the web plate shall not extend above the backs of the flange angles and shall not be more than  $\frac{1}{8}$  inch below any point. Any portion of the plate projecting beyond the angles shall be chipped flush with the backs of the angles. Web plates of girders having cover plates may be  $\frac{1}{2}$  inch less in width than the distance back to back of flange angles.

Splices in webs of girders without cover plates shall be sealed on the top by welding.

At web splices, the clearance between the ends of the web plates shall not exceed  $\frac{3}{8}$  inch. The clearance at the top and bottom ends of the web splice plates shall not exceed  $\frac{1}{4}$  inch.

(29) **Bent Plates.** Cold-bent load-carrying rolled-steel plates shall conform to the following: (a) They shall be so taken from the stock plates that the bend line will be at right angles to the direction of rolling. (b) The radius of bends, measured to the concave face of the metal, shall not be less and preferably shall be greater than shown in the following table, in which "T" is the thickness of the plate:

Angle through which plate is bent	Minimum radius
61 degrees to 90 degrees.....	1.0 T
91 degrees to 120 degrees.....	1.5 T
121 degrees to 150 degrees.....	2.0 T

If a shorter radius is essential, the plates shall be bent hot. Hot-bent plates shall conform to requirement (1) above. (c) Before bending, the corners of the plate shall be rounded to a radius of  $\frac{1}{16}$  inch throughout that portion of the plate at which the bending is to occur.

(30) **Fit of Stiffeners.** End stiffener angles of girders and stiffener angles intended as supports for concentrated loads shall be milled or ground to secure an even bearing against the flange angles. Intermediate stiffener angles shall fit sufficiently tight to exclude water after being painted. Fillers under stiffeners shall fit within  $\frac{1}{4}$  inch at each end. Welding will be permitted in lieu of milling or grinding if noted on the plans or specified in the special provisions. Welding transversely across the tension flanges of beams or girders, which have a flange stress of more than 75 percent of their designed capacity, will not be permitted.

(31) **Eyebars.** Eyebars shall be straight, true to size, and free from twists, folds in the neck and head, and other defects. The heads shall be made by upsetting and rolling or forging,

and not by welding. The form of the heads will be determined by the dies in use at the works where the eyebars are made, if they are satisfactory to the engineer. The thickness of the head and neck shall not overrun more than  $1 \frac{1}{6}$  inch. Eye bars that are to be placed side by side in the structure shall be bored so accurately that upon being placed together, pins  $\frac{1}{32}$  inch less in diameter than the pin holes will pass through the holes at both ends at the same time without driving.

**(32) Annealing and Stress Relieving.** Before boring, eyebars shall be annealed to produce the required physical qualities and shall be straightened. Proper instruments shall be provided for determining at any time the temperature of the bars. Members, such as bridge shoes, pedestals, or other parts which are built up by welding sections of plate together, shall be stress relieved in accordance with the provisions of the American Welding Society. Crimped stiffeners need not be annealed.

**(33) Pins and Rollers.** Pins and rollers shall be accurately turned to the dimensions shown on the drawings and shall be straight, smooth, and free from flaws. Pins and rollers more than 7 inches in diameter shall be forged and annealed. Pins and rollers 7 inches or less in diameter may be either forged and annealed or cold-finished carbon-steel shafting.

In pins larger than 9 inches in diameter, a hole not less than 2 inches in diameter shall be bored full length along the axis after the forging has been allowed to cool to a temperature below the critical range under suitable conditions to prevent injury by too rapid cooling, and before being annealed.

**(34) Boring Pin Holes.** Pin holes shall be bored true to the specified diameter, smooth and straight, at right angles with the axis of the member and parallel with each other unless otherwise required. The final surface shall be produced by a finishing cut.

The distance outside to outside of holes in tension members and inside to inside of holes in compression members shall not vary from that specified more than  $\frac{1}{32}$  inch. Boring of holes in built-up members shall be done after the riveting is completed.

**(35) Pin Clearances.** The diameter of the pin hole shall not exceed that of the pin by more than  $\frac{1}{50}$  inch for pins 5 inches or less in diameter, or  $\frac{1}{32}$  inch for larger pins.

**(36) Screw Threads.** Threads for all bolts and pins for structural steel construction shall conform to the American National Coarse Thread Series, Class 2, free fit, except that the pin ends having a diameter of  $1\frac{3}{8}$  inches or more shall be threaded 6 threads to the inch.

**(37) Pilot and Driving Nuts.** Two pilot nuts and two driving nuts for each size of pin shall be furnished, unless otherwise specified.

**42.06 MILL AND SHOP INSPECTION.** Materials are subject to inspection as specified under Section 48, "Structural Steel."



**42.07 MARKING AND SHIPPING.** (1) **Marking and Shipping.** Each member shall be painted or marked with an erection mark for identification and an erection diagram shall be furnished with erection marks shown thereon.

The contractor shall furnish, to the engineer, as many copies of material orders, shipping statements and erection diagrams as the engineer may direct. The weights of the individual members shall be shown on the statements. Members weighing more than 3 tons shall have the weights marked thereon. Structural members shall be loaded on trucks or cars in such a manner that they may be transported and unloaded at their destination without being excessively stressed, deformed or otherwise damaged.

Bolts and rivets of one length and diameter and loose nuts or washers of each size shall be packed separately. Pins, small parts and packages of bolts, rivets, washers and nuts shall be shipped in boxes, crates, kegs or barrels, but the gross weight of any package shall not exceed 300 pounds. A list and description of the contained material shall be plainly marked on the outside of each shipping container.

(2) **Handling Material.** The loading, transportation, unloading, and storing of structural material shall be conducted so that the metal will be kept clean and free from injury.

**42.08 ERECTION.** The contractor shall erect the metal work, remove the temporary construction, and do all the work required to complete the bridge or bridges as covered by the contract, including the removal of the old structure or structures, if stipulated, all in accordance with the plans and these specifications.

(a) **Masonry.** If the substructure and superstructure are built under separate contracts, the State will provide the masonry, constructed to correct lines and elevations and properly finished, and will establish the lines and elevations required for setting the steel.

(b) **Plant.** The contractor shall provide the falsework and all tools, machinery and appliances, including drift pins and fitting-up bolts, necessary for the expeditious handling of the work.

(c) **Handling and Storing Materials.** Material to be stored shall be placed on skids above the ground. It shall be kept clean and properly drained. Girders and beams shall be placed upright and shored. Long members, such as columns and chords, shall be supported on skids placed near enough together to prevent injury from deflection. If the contract is for erection only, the contractor shall check the material turned over to him against the shipping lists and report promptly in writing any shortage or injury discovered. He shall be responsible for the loss of any material while in his care, or for any damage caused to it after being received by him.



(d) **Falsework.** The falsework shall be properly designed and substantially constructed and maintained for the loads which will come upon it. The contractor, if required, shall prepare and submit to the engineer for approval, plans for falsework or for changes in an existing structure necessary for maintaining traffic. Approval of the contractor's plans shall not be considered as relieving the contractor of any responsibility.

(e) **Methods and Equipment.** Before starting the work of erection, the contractor shall inform the engineer fully as to the method of erection he proposes to follow, and the amount and character of equipment he proposes to use, which shall be subject to the approval of the engineer. The approval of the engineer shall not be considered as relieving the contractor of the responsibility for the safety of his method or equipment or from carrying out the work in full accordance with the plans and specifications. No work shall be done until such approval by the engineer has been obtained.

(f) **Bearing and Anchorage.** Masonry bearing plates shall not be placed upon bridge-seat bearing areas which are improperly finished, deformed or irregular. Bearing plates shall be set level in exact position and shall have a full and even bearing upon the masonry. Unless otherwise directed by the engineer, they shall be placed on a layer of canvas and red lead applied as follows:

Thoroughly swab the bridge-seat bearing area with red lead paint and place upon it three layers of 12 to 14 ounce duck, each layer being thoroughly swabbed on its top surface with red lead paint. Place the superstructure shoes or pedestals in position while the paint is plastic.

In setting shoes or bearing plates for steel truss spans proper allowances shall be made for bottom chord elongation due to dead load.

Anchor bolt holes shall be drilled in the correct locations or may be formed by the insertion in fresh concrete of oiled wooden plugs, metal pipe sleeves or other approved devices which are subsequently withdrawn after the concrete has partially set. If the holes are drilled the anchor bolts shall first be dropped into the dry holes to assure their proper fit after setting. If the holes are correct the bolts shall then be removed and the holes shall be filled about  $\frac{2}{3}$  full of Portland Cement grout and by a uniform, even pressure or by light blows with a hammer (flogging and ramming will not be permitted) force the bolt down until the grout rises to the top of the hole and the anchor bolt nut rests firmly against the metal shoe or pedestal. When the holes are formed by the latter method, they shall be not less than 4 inches in diameter to allow for horizontal adjustment of the bolts. The exact location of the anchor bolts shall then be determined and the anchor bolts shall be grouted in the holes with Portland Cement grout. All excess grout shall be removed in order to permit proper painting of metal surfaces.

In lieu of the above specified methods of placing anchor bolts, they may be set to exact location in the concrete when it is placed. If this method is used great care shall be exercised to insure the proper setting of the bolts and any inaccuracies which will be detrimental to the structure shall be corrected by a means approved by the engineer.

The location of the anchor bolts in relation to the slotted holes in the expansion shoes shall correspond with the temperature at the time of erection. The nuts on anchor bolts at the expansion ends of spans shall be adjusted to permit the free movement of the span.

**(g) Straightening Bent Material.** The straightening of plates and angles or other shapes shall be done by methods not likely to produce fracture or other injury. The metal shall not be heated unless permitted by the engineer, in which case the heating shall not be to a higher temperature than that producing a dark "cherry red" color. After heating, the metal shall be cooled as slowly as possible.

Following the straightening of a bend or buckle, the surface of the metal shall be carefully inspected for evidence of fracture.

**(h) Assembling Steel.** The parts shall be accurately assembled as shown on the plans and any match-marks shall be followed. The material shall be carefully handled so that no parts will be bent, broken, or otherwise damaged. Hammering which will injure or distort the members shall not be done. Bearing surfaces and surfaces to be in permanent contact shall be cleaned before the members are assembled. Unless erected by the cantilever method, truss spans shall be erected on blocking so placed as to give the trusses proper camber. The blocking shall be left in place until the tension chord splices are fully riveted and all other truss connections pinned and bolted. Rivets in splices of butt joints of compression members and rivets in railings shall not be driven until the span has been swung. Splices and field connections shall have one half of the holes filled with bolts and cylindrical erection pins (half bolts and half pins) before riveting. Splices and connections carrying traffic during erection shall have three-fourths of the holes so filled.

Fitting-up bolts shall be of the same nominal diameter as the rivets, and cylindrical erection pins shall be 1/32 inch larger.

**(i) Riveting.** Pneumatic hammers shall be used for field riveting, except when the use of hand tools is permitted by the engineer. Rivets larger than 7/8 inch in diameter shall not be driven by hand. Cup-faced dollies, fitting the head closely to insure good bearing, shall be used. Connections shall be accurately and securely fitted up before the rivets are driven. Drifting shall be only such as to draw the parts into position and not sufficient to enlarge the holes or distort the metal. Unfair holes shall be reamed or drilled. Rivets shall be heated uniformly to a light cherry-red color and shall be driven while hot. They shall not be overheated or burned.

Rivet heads shall be full and symmetrical, concentric with the shank, and shall have full bearing all around. They shall not be smaller than the heads of the shop rivets. Rivets shall be tight and shall grip the connected parts securely together. Caulking or re-cupping will not be permitted. In removing rivets, the surrounding metal shall not be injured; if necessary, they shall be drilled out. Field driven rivets shall be inspected and accepted before being painted.

**(j) Bolted Connections.** In bolted connections, the bolts shall be drawn up tight and the threads burred at the face of the nut with a pointed tool.

**(k) Pin Connections.** Pilot and driving nuts shall be used in driving pins. They shall be furnished with the steel work and shall be returned to the State on completion of the work. Pins shall be so driven that the members will take full bearing on them. Pin nuts shall be screwed up tight and the threads burred at the face of the nut with a pointed tool.

**(l) Misfits.** Corrections of minor misfits and a reasonable amount of reaming and cutting of excess stock from rivets will be considered a legitimate part of the erection. Any error in shop work which prevents the proper assembling and fitting up of parts by the moderate use of drift pins or a moderate amount of reaming and slight chipping or cutting, shall be reported immediately to the inspector, and his approval of the method of correction obtained. The correction shall be made in the presence of the inspector, who will check the work and material. The contractor shall be responsible for all misfits, errors and injuries and shall make the necessary corrections and replacements.

**(m) Removal of Old Structure and Falsework.** If stipulated in the contract, the contractor shall dismantle the old structure and dispose of it as stipulated under Subsection 40.00, "Removal of Existing Structures."

Upon completion, and before final acceptance, the contractor shall remove all falsework, excavated or useless materials, rubbish and temporary buildings, replace or renew any fences damaged, and restore in acceptable manner all property, both public and private, which may have been damaged during the prosecution of his work, and shall leave the bridge site and adjacent highway in a neat and presentable condition satisfactory to the engineer. All falsework piling shall be pulled or cut off 1 foot below finished ground line where conditions will permit. If conditions are not favorable for pulling or cutting off the piles as stated above, the piles shall be either broken or shot off at the stream bed, unless otherwise provided by the engineer. All excavated material or falsework placed in the stream channel during construction shall be removed by the contractor before final acceptance.

**(n) Inspection.** The work shall be subject at all times to inspection by the engineer.

**42.09 LAWS AND PERMITS.** The contractor shall comply with Federal, State and local laws, regulations, and ordinances, and shall obtain, at his own expense, the necessary permits for his operations.

**42.10 PAINTING. (a) General.** The painting of metal structures shall include, unless otherwise provided in the contract, the proper preparation of the metal surfaces, the application, protection and drying of the paint coatings, the protection of pedestrian, vehicular or other traffic upon or underneath the bridge structure, the protection of all portions of the structure (superstructure and substructure) against disfigurement by spatters, splashes and smirches of paint or of paint materials, and the supplying of all tools, tackle, scaffolding, labor, workmanship and materials necessary for the entire work.

**(b) Application.** All new structural steel work shall, unless otherwise especially provided upon the plans or in the contract, be given three coats of paint. The painting shall be done in a neat and workmanlike manner. Paint shall be applied in full coats, either with brushes or spray, so that every part of the surface is completely covered.

When paint is applied with brushes the paint shall be so manipulated under the brush as to procure a uniform, even coat in close contact with the metal or with previously applied paint. In general, the primary movement of the brush shall describe a series of small circles to thoroughly fill all irregularities in the surface, after which the coating shall be brushed out and smoothed by a series of parallel strokes until the paint film has an even thickness. Brushes preferably shall be round or oval in shape, but if flat brushes are used they shall not exceed 4 inches in width.

If spraying equipment is employed, it shall be of a type that will insure a satisfactory application of the paint specified. When spraying is used, the pressure tank shall have an agitator to keep the paint thoroughly stirred.

The paint shall be thoroughly stirred previously by means of approved mechanical mixers before being removed from the containers, and the pigments shall be kept in suspension by stirring during the application. When the quantity of each coat of paint required is 5 gallons or less, the engineer may, at his discretion, approve hand mixing.

If it is necessary in cool weather to thin the paint in order that it may spread more freely, such thinning shall be done only by heating in hot water or on steam radiators.

On all surfaces which are inaccessible for paint brushes, the paint shall be applied with spray or sheepskin daubers especially constructed for the purpose.

Paint shall be applied only when the air temperature is at or above 40°F. It shall not be applied upon damp surfaces or upon metal containing frost, nor shall it be applied when the air is misty or when, in the opinion of the engineer, conditions are unsatisfactory for the work.



Materials painted under cover in damp or cool weather shall remain under cover until dry or until weather conditions permit their exposure in the open. Painting shall not be done when the metal is hot enough to cause the paint to blister and produce a porous paint film.

The contractor shall be responsible for the satisfactory application of paint, and neither weather conditions nor the laboratory acceptance of materials used in the paint shall relieve him of the responsibility of obtaining a satisfactory paint job. If, in the opinion of the engineer, the painting is unsatisfactory, the paint shall be removed and the metal thoroughly cleaned and repainted. No additional allowance will be made because of any expense incurred because of these requirements.

**(c) Cleaning.** Surfaces of metal to be painted shall be thoroughly cleaned, removing rust, loose mill or welding scale, dirt, oil or grease, and other foreign substances. The removal of rust scale, and dirt shall be done by the use of metal brushes, scrapers, chisels, hammers, sand blasting, flame cleaning, or other effective means. Oil and grease shall be removed by the use of gasoline or benzine. Bristle brushes shall be used for removing loose dust.

**(d) Shop Paint.** All metal surfaces, except surfaces to be in contact after erection, shall receive one coat of red lead paint or zinc chromate primer meeting the requirements of shop coat set forth elsewhere in these specifications, unless otherwise specified herein or in the contract. The shop coat shall be applied immediately after fabrication, shop inspection and shop cleaning have been completed and the work has been accepted. Metal surfaces to be in contact after erection shall not be painted. Material shall not be loaded for shipment until the paint is dry.

Erection marks for the field identification of members shall be painted on painted surfaces.

With the exception of abutting chord and column splices and column and truss shoe bases, machine-finished surfaces shall be coated as soon as practicable after being accepted, and before removal from the shop, with a hot mixture of white lead and tallow. Surfaces of iron and steel castings machine-finished for the sole purpose of removing scales, scabs, fins, blisters or other surface deformation shall be given the shop coat of paint.

The composition used for coating machine-finished surfaces shall be mixed in the following proportions: 4 pounds tallow, 2 pounds white lead, and 1 quart linseed oil.

**(e) Field Cleaning.** When the erection work, including all riveting, straightening of all bent material, etc., is complete, all adhering rust, scale, dirt, grease, unsatisfactory shop paint and other foreign matter shall be removed as specified herein under Paragraph (c) of this article.



(f) **Field Painting.** The outside faces of end floorbeams, the bottom of expansion devices, and all parts of steel work inaccessible for painting after erection, are to be thoroughly cleaned of all foreign matter, spot coated and painted their two field coats before erection. This painting shall be done on the site of erection and prior to the placement of the material to allow the paint to become thoroughly dry before assembling. Material so painted shall be placed in a position to require a minimum of handling after being painted, the handling to be done in such a manner as not to damage or abrade the painted surfaces. In case these painted surfaces are damaged during erection, they shall be properly repainted.

After erection and as soon as the field cleaning is done to the satisfaction of the engineer, the spot coat shall be applied to the heads of all field rivets, bolts, pins and nuts, to all abrasions of the shop coat, and to all surfaces on which the shop coat has become damaged. In certain cases where a large portion of shop coat has become defective due to long periods of storage or due to the action of water, mud or other substance, the engineer may require a substantially complete reconditioning or replacement of the shop coat. All such painting shall be considered as spot coat work.

All small cracks and cavities which have not been sealed in a water-tight manner by the first field coat, shall be sealed with red lead paste before second field coat is applied.

To secure a maximum thickness of paint film over rivet heads and edges of plates, angles and other rolled shapes, these parts shall be painted an extra coat in advance of the general application of each field coat.

All metal, after the field cleaning has been completed and the spot coat has dried thoroughly, shall be given two coats of field paint consisting of the first field or primer coat and one coat of aluminum paint as specified under Section 54, "Paints for Wood and Metal," unless otherwise provided in the contract. In no case shall a succeeding coat be applied until the previous coat has dried throughout the full thickness of the paint film. This will require at least 48 hours drying time between successive coats during suitable weather. During unsuitable weather, the interval between successive coats shall be increased at the discretion of the engineer.

Field painting of structural steel shall not be started prior to May 1, nor shall it continue later than September 30, except on written permission of the engineer.

**42.11 METHOD OF MEASUREMENT.** The quantities of the various items which constitute the completed and accepted structure will be measured for payment according to the plans and specifications for the several items. Only accepted work will be included and the dimensions used will be those shown on the plans or ordered in writing by the engineer.

**42.12 BASIS OF PAYMENT.** The measured quantities, as provided above, will be paid for at the contract unit prices bid for the several items, which prices shall be full compensation for furnishing, fabricating, welding, erecting, painting, hauling, and placing of all materials and for all labor, tools, equipment and incidentals necessary to complete the work. Such payment shall constitute full payment for the completed structure ready for use. Miscellaneous items not listed in the proposal but shown or billed on the drawings shall be included in the price bid for the other items. No additional allowance will be made for cofferdam construction, falsework, form lumber or other erection expense.

Item Number	Item Description	Unit
4210	Dismantling and Erecting Truss	Lump Sum
4220	Floor Drain	Each



**SECTION 43**

**TIMBER STRUCTURES**



**43.01 DESCRIPTION.** Work and materials under this section shall consist of timber structures constructed in conformity with the plans or as ordered in writing by the engineer, and in accordance with this and other specification items involved.

**43.02 MATERIALS. (a) Timber and Lumber.** All timber and lumber shall be of the species and grades called for on the plans and as specified in the special provisions.

**(b) Hardware.** Bolts, drift pins and dowels may be either wrought iron or medium steel. Washers shall be cast, ogee gray iron castings or malleable castings, unless cut washers are specified on the plans. Ring or shear plate timber connectors shall be of approved design and made of hot rolled low carbon steel A.S.T.M. A17, Type "A" grade.

**(1) Bolts.** Bolts shall be of the sizes specified and must be perfect in every respect. They shall have square or carriage heads and square nuts, provided however, that large-head type timber bolts of approved design may be used. Screw threads shall make close fits in the nuts. The bolts provided shall be of proper length to protect beyond nuts not more than  $\frac{1}{2}$  inch nor less than  $\frac{1}{4}$  inch. When bolts are not provided in the proper lengths, the bolts shall be cut off or re-threaded to comply with this requirement. All bolts shall be effectively checked after the nuts are adjusted.

**(2) Washers.** Washers shall be used between all bolt heads and nuts and the wood, except that carriage bolts, or large-head type timber bolts, shall have washers under nuts only. Cast washers shall have a thickness equal to the diameter of the bolt and a diameter of four times the thickness. For malleable or plate washers, the diameter or side size of the square shall be equal to four times and the thickness equal to one-half the diameter of the bolt. Cast iron washers shall be used when the timber is in contact with earth.

**(3) Galvanized Hardware.** All bolts, rods, hold-down straps, lag screws, turn bolts, cable clamps, anchor cable, all nuts and washers (except cast-iron washers), drains and sheet iron shall be galvanized by the Hot Dip Method and shall have a continuous coating of pure zinc of a uniform thickness so applied that it will adhere firmly to all surfaces, and shall be capable of withstanding 4 immersions in a standard test solution of copper sulphate without showing any trace of metallic copper on the steel in accordance with the Preece Test, ASTM METHOD A239. The first 3 immersions shall be for a period of 1 minute each and the 4th immersion for a period of  $\frac{1}{2}$  minute. Drift pins, dowels and nails may be furnished ungalvanized.

The contractor may use pure zinc sheets, aluminum, copper or any other approved non-rusting material of equal thickness in lieu of the 22 gauge galvanized sheets specified for capping the pile heads and flashing the drain openings. Aluminum or aluminum alloy sheets shall be installed using lead-headed nails or with lead washers under the heads of regular nails of the sizes specified.

(c) **Bridge Iron.** Steel truss rods, structural shapes, and plates shall conform to the requirements of the standard specifications for steel for bridges of the A.S.T.M., Serial Designation A7. No welds in truss rods will be permitted. All plates or shapes which are heated to facilitate bending shall be properly annealed. Steel castings shall conform to the requirements of the standard specifications for steel castings of A.S.T.M., Serial Designation A27, and shall be grade 65-35. Iron castings shall conform to the requirements of the standard specifications for gray iron castings of the A.S.T.M., Serial Designation A48.

**43.03 METHOD OF CONSTRUCTION.** (a) **Handling of Materials.** Treated timber shall be carefully handled without sudden dropping, breaking of outer fibers, bruising or penetrating the surface with tools. It shall be handled with rope slings. Cant dogs, hooks, or pike poles shall not be used.

(b) **Storage of Materials.** Timber on the site of the work shall be stored in piles. The ground underneath and adjacent to material piles shall be cleared of weeds and rubbish. Untreated material shall be close-stacked at least 12 inches above the ground surface and piled to shed water and prevent warping. When requested by the engineer, it shall be protected from the weather by suitable covering. Treated material shall be close-stacked to prevent warping.

(c) **Treatment of Breaks.** All places where the surface of treated timber is broken by the cutting, boring, or otherwise, shall be thoroughly coated with hot creosote oil and then with a coating of hot tar.

(d) **Temporary Attachment.** Whenever, with the approval of the engineer, forms or temporary braces are attached to treated timber with nails or spikes, the holes shall be filled by driving galvanized nails or spikes flush with the surface, or plugging with creosoted plugs after treating with creosote oil.

(e) **Bearing.** Post and pile caps shall be level and have full even bearing on all posts or piles in the bent and be secured to each pile or post by  $\frac{3}{4}$  inch diameter drift pin extending at least 9 inches into the pile or post at the approximate center thereof.

(f) **Sills and Mud Sills.** Timber used for mud sills shall conform to the requirements shown on the plans or in the special provisions. Mud sills shall be firmly and evenly bedded to solid bearing and tamped in place. Sills shall have true and even bearing on mud sills, piles or pedestals. They shall be drift-bolted to mudsills or piles with bolts of not less than  $\frac{3}{4}$  inch diameter and extending into mud sills or piles at least 6 inches. When possible, all earth shall be removed from contact with sills so that there will be free air circulation around them.

(g) **Framing.** Truss and bent timbers shall be accurately cut, and framed to a close fit in such manner that they will have even bearing over the entire contact surface of the



joint. No blocking or shimming of any kind will be allowed in making joints, nor will open joints be accepted. Mortises shall be true to size for their full depth and tenons shall make snug fit therein.

Cross-bridging between stringers shall be neatly and accurately framed and securely toe-nailed with at least 2 nails in each end. All cross-bridging members shall have full bearing at each end against the sides of stringers. Unless otherwise specified on the plans, cross-bridging shall be placed at the center of each span.

Timber to be treated for preservation shall be cut and framed prior to treatment. No unnecessary cutting will be allowed after treatment.

**(h) Bolt Holes.** Holes for round driftpins and dowels shall be bored with a bit 1/16 inch smaller in diameter than the pin or dowel to be used. The diameters of holes for square driftpins or dowels shall be equal to the least dimension of the pin or dowel. Holes for bolts shall be bored with a bit of the same diameter as that of the bolt. Holes for lag screws shall be bored with a bit not larger than the body of the screw at the base of the thread. Holes for rods shall be bored with a bit 1/16 inch greater in diameter than the rod. All holes in treated timber bored after treatment shall be treated with an approved pressure bolt hole treater; holes for rods shall be effectively sealed with hot tar or other suitable waterproofing after insertion of rods.

Countersinking shall be done wherever smooth faces are required. Horizontal recesses formed for countersinking shall be painted with hot creosote oil and, after the bolt or screw is in place, shall be filled with hot tar.

**(i) Stringer Sizing.** Stringers shall be sized at bearing only. Outside stringers shall have butt joints but interior stringers shall be framed to bear over the full width of floor beam or cap at each end. The ends shall be securely fastened to the timber on which they rest. When untreated timbers are used, they shall be separated at least 1/2 inch for the circulation of air.

**(j) Roadway Floors.** Roadway floors shall be of the strip or laminated type and shall be surfaced S1S1E or S4S. Each lamina shall have a nominal thickness of 2 inches and a width as shown on the plans, and shall be full length except as otherwise permitted on the plans. Unless otherwise specified, they shall be sized to a uniform width and shall not vary in thickness from end to end. Each lamina shall be toe-nailed to alternate stringers with 20d nails and face nailed to adjacent laminae with 20d nails at 18-inch centers, staggered. Where splices are permitted, the splice shall be made on the centerline of a stringer and each piece shall be of sufficient length to bear on at least 4 stringers. Splices shall be made at any one stringer no oftener than every third lamina, and splices in adjacent laminae shall not occur on adjacent stringers. All floors shall be cut to a straight line along the sides of the roadway. Upon written permission of the engineer, the

contractor may adjust the spacings of stringers to reduce wastage in cutting laminated decking from commercial length timbers. Approval of the revised stringer spacings shall be obtained before work is started, but in no case shall the spacing of stringers in the center portion of the roadway exceed 27 inches for 2" x 4" decking.

**(k) Surface Treatment of Deck.** After laminated decking is laid, and curbs, with drains as specified, are completed, the entire top surface of deck and the inside surfaces of curbs, shall be treated with three coats of hot tar conforming to requirements set forth in the A.S.T.M., Serial Designation D 490-T Grade T-7 or T-8. (T-7 is adapted to cold weather application, T-8 to warm weather application.) This is a tar having a float of 50 to 120 seconds at 32°C.

The tar shall be heated in an open tank or kettle to a temperature between 200 and 225 degrees F. and then applied evenly to the surfaces to be treated at the rate of  $\frac{1}{4}$  gallon per square yard. Three coats shall be applied at this rate, each coat being given a sufficient time to cool and set up before the application of the succeeding coat is begun.

After the final coat of tar has had sufficient time to cool and set up, and before any vehicles are allowed on the structure, the entire surface of the deck shall be covered with aggregate surfacing at the rate of one cubic yard of material per 24 square yards of surface area. The aggregate surfacing shall conform to the requirements of Type "A" grading 2 or 3, or Type "B" grading 3 given in Section 25, except that crushing will not be required and the amount of material passing the 200 mesh sieve shall not exceed 10 percent. The cost of all materials, equipment and labor necessary and incidental to this surface treatment of deck, as well as the materials and labor incidental to the construction of the drain openings in curbs, shall be included in the price bid per thousand feet board measure for treated or untreated lumber in place.

**(l) Wheel Guards.** Wheel guards shall be constructed as shown on the plans and shall be bolted to the outside stringers by  $\frac{3}{4}$  inch machine or hook bolts spaced not more than 5 feet center to center. All joints shall be lapped and a bolt shall pass through each lapped joint. When the wheel guard is not blocked up from the floor, drain holes shall be provided at such intervals as to drain the roadway adequately. They shall be provided with galvanized iron lining and arranged so as to discharge free of the structure.

**(m) Railing.** Railing shall be built as shown on the plans and shall be constructed in a workmanlike and substantial manner. Unless otherwise noted, all railing material shall be untreated timber and shall be dressed on 4 sides. All rail shall be squarely jointed at the posts and the rails shall break joints. Nailing of railing to posts will not be permitted.

**43.04 PAINTING UNTREATED TIMBERS.** The following surfaces shall be thoroughly coated with two (2) coats of hot creosote oil before the timbers are assembled: Ends, tops and

all contact surfaces of posts, sills, caps, floorbeams and stringers; all ends, joints and contact surfaces of bracing and truss members. All surfaces of timber bumpers, the back face of bulkheads and all other untreated timber which is to be in contact with earth shall be similarly treated.

Unless otherwise specified, untreated timber handrail and posts shall be painted with three (3) coats of paint conforming to the specifications for paints for woods as hereinafter set forth under Section 54, "Paints for Wood and Metal." All timber to be painted must be seasoned, and painting shall be done only when the timber is free from frost and the surface is perfectly dry and clean. No painting shall be done in damp or freezing weather. All paints shall be thoroughly dry before applying the succeeding coats. It shall be applied in good heavy coats, completely covering every part of the surface and shall be worked into the joints and open spaces; it shall be so thoroughly and evenly spread that no excess paint will collect at any point.

**43.05 METHOD OF MEASUREMENT.** The quantities of timber and other contract pay items in the completed and accepted structure shall be measured for payment in the manner prescribed for the several items involved.

**43.06 BASIS OF PAYMENT.** The quantities of the several contract pay items as measured above, except truss spans, shall be paid for at the contract unit prices bid for the several items involved, complete in place, according to the plans, or as directed in writing by the engineer, which prices shall be full compensation for all material, tools, equipment, labor and all incidentals necessary to complete the structure ready for use.

Timber trusses complete shall be paid for at the price bid per span complete, as shown on the plans, which shall include all parts of the bridge except abutments and piers. This price shall be full compensation for all materials, structural steel, steel or iron castings, hardware, equipment, tools, labor, painting, preservative treatment, surface treatment of deck, and all incidentals necessary to complete the structure ready for use.

Item Number	Item Description	Unit
4310	Timber Truss	Lineal Foot



## **SECTION 44**

# **BOX CULVERTS AND RETAINING WALLS**



**44.01 DESCRIPTION.** Work and materials under this section shall consist of the furnishing of the necessary materials and the construction of concrete and masonry culverts, culvert pipe headwalls, or retaining walls conforming to the lines, grades and dimensions given, and in accordance with the specifications for concrete and other items which are to constitute the completed structure.

**44.02 MATERIALS.** All materials used shall be those prescribed for the several items which constitute the structure.

**44.02 METHOD OF CONSTRUCTION.** All foundations shall be prepared as specified under Subsection 11.60 "Excavation for Culvert and Retaining Walls," and they shall be inspected and approved by the engineer previous to placing any footing.

In general, the base slab or footings of box culverts and retaining walls shall be placed and allowed to set before the walls are constructed. Before concrete is placed in the walls, the footings shall be thoroughly cleaned of all shavings, sticks, sawdust, or other extraneous material and the surface carefully chipped and roughened in accordance with the method of bonding construction joints as specified under Paragraph (i), "Construction Joints," Article 46.05, Subsection 46.00, "Portland Cement Concrete."

In the construction of box culverts 4 feet or less in height, the sidewalls and top slab may be constructed as monolith. When this method of construction is used, any necessary construction joints shall be vertical and at right angles to the axis of the culvert.

Each wing wall shall be constructed, if possible, as a monolith. Construction joints, where unavoidable, shall be horizontal and so located that no joint will be visible in the exposed face of the wing wall above the ground line.

Drains through all walls are to be placed as shown on plans or as directed by the engineer in the field.

**44.04 METHOD OF MEASUREMENT.** The quantities of the various items which constitute the completed and accepted structures shall be measured for payment according to the plans and specifications for the several items. Only accepted work will be included and the dimensions used will be those shown on the plans or ordered in writing.

**44.05 BASIS OF PAYMENT.** The measured quantities as provided above shall be paid for at the contract unit prices bid for the several items, which prices shall be full compensation for furnishing, hauling, and placing all material, all labor, equipment, tools, drains, and necessary incidentals. Such payment shall constitute full payment for the completed structures ready for use.

**NOTE:** There are no pay items under this section.





**SECTION 45**

**EXCAVATION FOR STRUCTURES**



**45.01 DESCRIPTION.** "Excavation for Structures" shall consist of all excavation for foundations for bridges, and all other major structures, and shall include the disposal of all material obtained from such excavation and backfilling to the level of the original ground. Unless otherwise specified by the plans and/or special provisions, it shall also include all necessary bailing, drainage, sheeting, and the construction of cribs or cofferdams if found necessary. The excess material shall be disposed of as directed by the engineer and in such manner as not to obstruct the stream or otherwise impair the efficiency or appearance of the structure or other parts of the work.

**45.02 CLASSIFICATION.** All material excavated shall be unclassified and paid for as unclassified excavation for structures, unless otherwise provided in special provisions. The excavation lines and bases of structures shown on the plans shall be considered as approximate only, and they may be ordered in writing by the engineer to be placed at any elevations, or of any dimensions necessary to give a satisfactory foundation, and no additional compensation will be allowed for any such alteration except as provided under "Basis of Payment," Article 45.05.

Boulders, logs, or any unforeseen obstacles encountered in excavating shall be removed and no additional compensation will be allowed for driving through or removing such obstructions.

All timber, sheeting, and other material used in making the excavation shall be removed except as ordered by the engineer, and the cost of performing this work shall be considered as included in the unit price bid for unclassified excavation for structures.

**45.03 METHOD OF CONSTRUCTION.** (a) **Depth.** All foundation excavation shall be carried to a depth satisfactory to the engineer, regardless of the elevations shown on the plans, and unsuitable material shall be replaced with approved material if required. If rock bottom is secured, the excavation shall be done in such a manner as to allow the solid rock to be exposed and prepared in horizontal beds for receiving the structure, except that for arch substructures, the bottom shall be sloped or stepped as directed by the engineer. All rock or hardpan foundation surfaces shall be freed from loose or disintegrated pieces, thin strata shall be removed, and the surfaces cut to firm bearing and cleaned to the satisfaction of the engineer.

(b) **Treatment of Foundation Materials.** Where concrete or masonry is to be placed on any excavated surface, special care shall be taken not to disturb the bottom of the excavation more than necessary, and the final removal of the material to grade shall not be made until just before the concrete or masonry is laid. All seams or crevices shall be cleaned out and filled with concrete mortar. When the excavation is at the required depth, water, if present, shall be pumped

out, if possible, for cleaning the foundation bed for inspection. The natural ground adjacent to the structures shall not be disturbed without permission of the engineer. The existing ground surface at and adjacent to each unit of the substructure shall not be disturbed except as necessary for the sinking of the cofferdams, and all excavation shall be restricted to the area inside of the cofferdams, unless otherwise approved by the engineer.

**(c) Cofferdams.** Cofferdams or cribs for foundation construction shall, in general, be carried well below the bottom of the footings and shall be well braced and as water-tight as practicable. In general, the interior dimensions of cofferdams shall be such as to give sufficient clearance for the construction of forms and the inspection of their exteriors, and to permit pumping outside of the forms. Cofferdams or cribs which are tilted or moved laterally during the process of sinking shall be righted or enlarged so as to provide the necessary clearance and this shall be at the sole expense of the contractor. Cofferdams shall be constructed so as to protect green concrete against damage from a sudden rising of the stream and to prevent damage to the foundation by erosion. No timber or bracing shall be left in cofferdams or cribs in such a way as to extend into the substructure masonry, without written permission of the engineer.

When required by the engineer, the contractor shall submit drawings showing his proposed method of cofferdam construction and other details left open to his choice or not fully shown on the plans. Such drawings shall be approved by the engineer before construction is started, but such approval shall not in any way relieve the contractor of his responsibility to secure a safe and satisfactory cofferdam.

When conditions are encountered which, in the opinion of the engineer, render it impracticable to unwater the foundation before placing masonry, he may require the construction of a concrete foundation seal of such dimensions as may be necessary. The foundation shall be pumped out and the balance of the masonry shall be placed in the dry. When weighted cribs are employed and the weight utilized to partly overcome the hydrostatic pressure acting against the bottom of the foundation seal, special anchorage such as dowels or keys shall be provided to transfer the entire weight of the crib into the foundation seal. When a foundation seal is placed under water, the cofferdam shall be vented or ported at low water level.

Unless otherwise provided, cofferdams or cribs with all sheeting and bracing shall be removed by the contractor after the completion of the substructure. The removal shall be effected in such a manner as not to disturb or mar the finished masonry.

**(d) Pumping.** Pumping from the interior of any foundation enclosure shall be done in such manner as to preclude the possibility of any portion of the concrete materials being carried away. No pumping will be permitted during the

placing of concrete, or for a period of at least 24 hours thereafter, unless it be done from a suitable sump separated from the concrete work by a water-tight wall. Pumping to underwater a sealed cofferdam shall not commence until the seal has set sufficiently to withstand the hydrostatic pressure.

**(e) Inspection.** After each excavation is completed, the contractor shall notify the engineer, and no footing shall be placed until after the engineer has approved the depth of the excavation and the character of the foundation material.

When required by the engineer, the contractor shall drill holes or drive rods in the bottom of the footings to ascertain the quality of the material.

**(f) Backfilling.** All spaces excavated and not occupied by abutments, piers or other permanent work shall be refilled with earth up to the surface of the surrounding ground, with a sufficient allowance for settlement. Where the backfill is to carry the roadway embankment or any part thereof, the backfill shall be made in continuous horizontal layers not greater than 8 inches in thickness, and each layer shall be thoroughly compacted by mechanical or hand tamping before the succeeding layer is placed as specified by pertinent provisions of Subsection 11.80, "Embankment." All other backfill shall be thoroughly compacted and its top surface shall be neatly graded.

All material used for backfill shall be of a quality acceptable to the engineer and shall be free from large or frozen lumps, wood or other extraneous material. In general, this material shall be selected from the material excavated in connection with the substructure involved. Jetting or ponding of the backfill will not be permitted. Water shall be used to expedite settlement of the backfill only when it is difficult to compact the materials, and ordered by the engineer.

The slope bounding the excavation for abutments and wing walls shall be destroyed by stepping or serrating to prevent wedge action.

Adequate provision shall be made for thorough drainage of all backfill by placing coarse gravel or broken stone around drain holes in wing and abutment walls as specified under Section 60, "Pipe Culverts" or shown on the plans.

For foundations through hard material exposed to erosion, the backfill around piers and in front of abutments and wings shall be made of the larger and heavier material selected from material removed from the excavation. If acceptable material is not available in sufficient quantity, the engineer may order said backfill to be made of stone or lean concrete; in which case, unless otherwise provided, this backfill shall be paid for as extra work.

No backfill shall be placed against any masonry abutment, wing wall or culvert until permission shall have been given by the engineer, and preferably not until the masonry has been in place 14 days.



The cost of performing this work shall be considered as included in the unit price bid for unclassified excavation for structures.

**(g) Spandrel Fill.** The spandrel fill of arch bridges shall be considered a part of the road embankment, shall be composed of earth or gravel, and shall be placed in layers of variable thickness simultaneously over all piers, abutments and arch rings. The lower six inches of material in direct contact with the arch ring waterproofing shall be of fine grading to avoid injury to the waterproofing. At all points the ratio of thickness of each layer to the total depth of the proposed fill shall be approximately constant. The maximum thickness of any layer shall not exceed 18 inches. This work shall be paid for at the contract unit price bid per cubic yard for unclassified excavation or borrow.

**(h) Approach Embankments.** When the contract for any bridge structure involves the placement of approach embankments, these shall be constructed and paid for in accordance with the standard specifications governing this class of work.

**45.04 METHODS OF MEASUREMENT.** The quantity of excavation for which payment will be made will be the volume in place within vertical planes, 18 inches outside of neat lines of footings, from the surface of the ground as it exists at the time when excavation is started, to the elevation shown on the plans, or to such elevation as the engineer may direct, unless otherwise indicated on the plans or in the special provisions. In case of tie beams, overhangs, or similar construction which extend beyond the footing lines, measurement of excavation shall be limited to 18 inches outside and below neat lines and parallel thereto, provided that the space so measured for payment shall include only that portion not measured for payment under the above paragraph.

**45.05 BASIS OF PAYMENT.** Payment for all work, prescribed under this item (except spandrel fill and approach embankments), and measured as provided above, shall be made at the contract unit price bid per cubic yard for unclassified excavation for structures, which price and payment shall be full compensation for furnishing all material, for all labor, equipment, tools and incidentals necessary to complete the work unless otherwise indicated on the plans or in the special provisions.

When it is necessary, in the opinion of the engineer, to carry the foundations below the elevations shown on the plans, the excavation for the first three feet of additional depth will be included in the quantity for which payment will be made under the item "Excavation for Structures."

Excavation below this additional depth will be paid for on the basis of extra work or at the contract price, as the contractor may elect, such choice to be made in writing before work is commenced.



The foregoing provisions shall apply to all and any increased quantities of excavation resulting from the lowering of bridge footings.

Item Number	Item Description	Unit
4510	Structure Excavation	Cubic Yard
4511	Structure Excavation	Lump Sum
4520	Structure Excavation Type I	Cubic Yard
4521	Structure Excavation Type I	Lump Sum
4530	Structure Excavation Type II	Cubic Yard
4531	Structure Excavation Type II	Lump Sum
4550	Shoring and Cribbs	Lump Sum



## **SECTION 46**

### **CONCRETE**



**SUBSECTION 46.00 PORTLAND CEMENT CONCRETE.**

**46.01 DESCRIPTION.** Concrete shall be composed of Portland Cement, fine aggregate, coarse aggregate, and water, prepared and constructed in accordance with these specifications, at the locations and of the form, dimensions, and classes shown in detail on the plans; provided, in addition, that any concrete described on the plans as air-entrained concrete shall meet also the requirements set forth below.

(a) **Air-Entrained Concrete.** Air-entrained concrete shall be used in all parts of the structure unless otherwise indicated on the plans. Air-entrained concrete shall be a concrete containing an air-entraining admixture and not an air-entraining Portland Cement.

(1) **Admixtures.** When an air-entraining admixture is used, the engineer will determine by trial the amount of admixture required to produce concrete having the specified air content and this amount shall not be varied except as directed by the engineer.

(2) **Proportions and Batch Weights.** The engineer shall determine the proportions and batch weights for air-entrained concrete in the manner prescribed in Article 46.03 for regular concrete; provided, however, that in making such adjustments as may be necessary by reason of entrained air, the engineer will use the minimum quantity of fine aggregate and the minimum quantity of water which in his judgment will produce concrete of the required workability.

(3) **Entrained Air.** Air-entrained concrete shall contain not less than 3% nor more than 5% entrained air, determined by means of the test for air content, A.A.S.H.O. T-152. Tests for entrained air shall be made by the engineer on concrete containing the materials to be used in the work and employing the type of mixer and mixing procedure which will be used in construction.

**46.02 CLASSIFICATION.** Concrete will be classified as Class 'A,' Class 'AD,' Class 'B,' Class 'D,' Class 'DD,' or Class 'S.' Each class of concrete shall be used in that part of the structure in which it is called for on the plans, or where directed. The following requirements shall govern unless otherwise shown on the plans.

Class "A" concrete shall be used for reinforced substructures, retaining walls and box culverts.

Class "AD" concrete shall be used for all superstructures, except where Class "D" or Class "DD" is specified on plans.

Class "B" concrete shall be used for mass footings, pedestals, massive pier shafts and gravity walls, with none or only a small amount of reinforcing.

Class "D" concrete shall be used for heavily reinforced posts, slabs, beams, girders and curbs having a minimum thickness of 5 inches.

Class "DD" concrete shall be used for sections less than 5 inches in thickness.

Class "S" concrete shall be used for all concrete deposited under water. The concrete of the various classes shall be designed so as to secure concrete which will meet the requirement of the table below.

Class	Minimum Compressive Strength		Maximum Size of Aggregate	Use
	7 days lb per sq. in.	28 days lb per sq. in.		
A	1600	2400	1½	Substructures, retaining walls and box culverts
AD	2000	3000	1½	Superstructures
B	1200	1800	2	Unreinforced sections
D	2000	3000	1	Heavily reinforced slabs, beams, etc.
DD	2000	3000	¾	Thin sections
S	1600	2400	1½	Concrete deposited under water

The strengths shown in the table above are the strengths below which not more than 10% of all tests may fall.

**46.03 COMPOSITION OF CONCRETE AND PROPORTIONING.** Immediately upon receipt of the award of the contract, the contractor shall furnish the engineer exact locations of sources of materials which he proposes to use. The engineer shall forward samples to the laboratory for testing. When materials are satisfactory the laboratory will determine the proportions and blends of aggregates and cement that will give the maximum durability and strength comparable with workable concrete.

The contractor shall put into each batch the amount of cement and the amount of water and shall weigh into each batch the respective weights of fine and coarse aggregate designated by the engineer for the particular materials being used and the class of concrete being made; except that in batching aggregates for structures containing less than 10 cubic yards of concrete, the contractor may substitute approved volumetric measuring devices in lieu of weighing devices. In such event, weighing will not be required but the volume of coarse aggregate and fine aggregate measured into each batch shall be those designated by the engineer.

Materials shall be proportioned by either method "A" or "B" given below. Method "B" shall be used except where Method "A" is specifically authorized by the special provisions.

(a) **Method "A."** Using master proportion tables. The engineer, subject to the requirements of the "Master Proportion Table," shall designate the respective amounts of the job materials to be used in the batch. The sum of the weights of fine and coarse aggregate designated for each class of concrete shall equal the "FIXED" weights shown in the "Total Aggregate" column for the respective classes of concrete either air free or air entrained. Within the ranges of the table, the engineer shall designate the weight of fine aggregate which, using the materials furnished, will produce a workable mix of the consistency specified, with the least amount of water.



Class	Maximum Size of Coarse Aggregate Sq. Mesh	Minimum Cement Factor	Weight of Fine Aggregate per Bag of Cement		Lbs.	Lbs.	Air free	Air Ent. 3 1/2 %	Maximum Net Water Content per Bag of Cement	Consistency Range in Slump	
			Min.	Max.						Vibrated	Placing Without Vibration
	Inches	Bags (94 lbs.) per yd.							Gallons	Inches	Inches
ROUND COARSE AGGREGATE											
A	1 1/2	5.5	190	230	595	570			6.0	1 1/2-3	
AD	1 1/2	6.5	135	165	470	450			6.0	1 1/2-3	
B	2	4.5	220	270	755	725			7.0	1-2	
D	1	6.5	135	165	470	450			6.0	1 1/2-3	
DD	3/4	6.5	145	175	470	450			6.0	1 1/2-3	
S	1 1/2	7.0	120	140	425	405			6.0		4-8
ANGULAR COARSE AGGREGATE											
A	1 1/2	5.5	225	275	595	570			6.0	1 1/2-3	
AD	1 1/2	6.5	170	210	470	450			6.0	1 1/2-3	
B	2	4.5	275	335	755	725			7.0	1-2	
D	1	6.5	170	210	470	450			6.0	1 1/2-3	
DD	3/4	6.5	180	220	470	450			6.0	1 1/2-3	
S	1 1/2	7.0	155	185	425	405			6.0		4-8

**Note**—Using the maximum allowable water content, the weights given above, when multiplied by the corresponding cement factors, will furnish a cubic yard of concrete.

The proportions by weight given in the table above are based on the maintenance of a constant water-cement ratio. The weights shown are based on the use of aggregates having bulk saturated surface dry specific gravities of 2.65. If gravities of materials used vary from this figure by .05 or more, correction shall be made by multiplying the figures shown in the table by the new gravity and dividing by 2.65. The bulk specific gravity test shall be made in accordance with A.A.S.H.O. Method T-84 and Method T-85.

Since the weights given in the table are computed for aggregates in the dry condition, the batch weights must be corrected for any moisture present in the aggregates as delivered to the measuring bin. Absorption tests shall be made in accordance with A.A.S.H.O. Method T-84 and T-85.

The weights of fine and coarse aggregate will be adjusted by the engineer to insure concrete of satisfactory plasticity and workability, using not more than the maximum permissible net water content shown. During the progress of the work, the total weight of aggregate per bag of cement shall not be changed except under the following conditions:

(1) If concrete of satisfactory plasticity and workability cannot be made without exceeding the maximum net water content, the engineer shall reduce the total weight of aggregate by an amount sufficient to insure that the maximum net water content will not be exceeded, and the contractor shall not receive additional compensation for any extra cement which may be necessary by reason of such adjustment.

(2) If, during the progress of the work, the specific gravity of one or both of the aggregates changes, the batch weights shall be changed accordingly.

**(b) Method "B."** Proportions based on laboratory design. The engineer shall furnish, to the laboratory, samples or approved sample numbers on which the design is to be based. The proportions of cement, aggregates and water necessary to conform to these specifications shall be determined by means of preliminary laboratory tests on concrete made with the cement and aggregates which are to be used in the work. The minimum cement factor shall be as set forth in the table below. For each class of concrete, the proportions of cement, fine and coarse aggregate, and the quantity of mixing water will be designed by the laboratory so as to meet the requirements of the following table:

Class	Maximum Size of Coarse Aggregate Sq. Mesh	Minimum Cement Content 94 lb. Bags	Minimum Compressive Strength		Maximum Net Water Content Per Bag of Cement	Consistency Range	
			7 Days	28 Days		In Slump Vibrated	Placing Without Vibration
	Inches		Lbs. per Sq. In	Lbs. per Sq. In	Gallons	Inches	Inches
A	1½	5.5	1600	2400	6.0	1½-3	
AD*	1½	6.5	2000	3000	6.0	1½-3	
B	2	4.5	1200	1800	7.0	1-2	
D	1	6.5	2000	3000	6.0	1½-3	
DD	¾	6.5	2000	3000	6.0	1½-3	
S	1½	7.0	1600	2400	6.0		4-8

\*Class "AD" concrete, when used in Portland cement concrete pavement, shall have a minimum compressive strength of 2,500 lbs. per sq. in. at 7 days and 4,000 lbs. per sq. in. at 28 days.

The strengths shown in the preceding table are the strengths below which not more than 10% of all tests may fall.

The designated proportions shall be used so long as the materials are actually furnished from the sources originally named and so long as they continue to meet the requirements herein specified, subject only to slight changes in the relative quantities of fine and coarse aggregate for the purpose of promoting workability and correcting for moisture in the aggregates.

If, during the progress of the work, the contractor wishes to use materials for which no approval or mix designs have been designated, the engineer shall secure samples of the new source and submit them to the laboratory for approval and new mix designs.

If, during the progress of the work, it is found impossible to obtain concrete of the required workability with the designated proportions, the engineer may make such changes in proportions as are deemed necessary to secure the desired workability, provided that in no case shall the ratio of water to cement be greater than is specified in the table above for the class of concrete involved.

**46.04 Material. (a) Cement and Admixtures.** The cement used in the work shall be a Portland Cement of the type or types shown on the plans, provided, however, that when not so shown, the type or types used shall be Type II for regular concrete. The concrete shall contain no admixture of any kind save as provided under (2) below.

**(1) Cement.** Portland Cement shall conform to the requirements of A.A.S.H.O. Specification M-85, Type I, II, III, IV or V as the case may be.

Low-alkali Portland Cement shall conform to the requirements of A.A.S.H.O. Specification M-85 for Type II with the additional requirement that the total alkali content calculated as the percentage of sodium oxide ( $\text{Na}_2\text{O}$ ) plus 0.658 times the percentage of potassium oxide ( $\text{K}_2\text{O}$ ) shall not exceed 0.6.

Only one brand of any one type of cement shall be used on the contract except by written permission by the engineer. If more than one brand or grade is permitted by the engineer, each shall be stored separately and shall not be used alternately in any pour. Different shipments of cement shall also be stored separately. The contractor shall provide suitable means for storing cement and protecting it from dampness.

Bags of cement, in which for any reason the cement has become partially set or which contain lumps of caked cement, shall be rejected; provided, however, that the cement from such bags, which is not partially set, caked or otherwise damaged, may be salvaged and used as bulk cement.

(2) **Air-Entraining Admixtures.** The air-entraining agents used shall be stipulated in the special provisions or approved by the engineer. The use of admixtures on which preliminary laboratory and field tests have not been made will not be permitted.

(b) **Water.** All water used in concrete shall be subject to the approval of the engineer and shall be reasonably clear and free from oil, acid or alkali and vegetable substances, and shall not be brackish or salty. Water of doubtful quality shall be tested in briquettes as prescribed in A.A.S.H.O. Method T-26, and the strength of such briquettes shall be equal to similar briquettes made of water of known satisfactory quality.

(c) **Aggregates.** To insure uniformity of grading, the gradation requirements given in this specification represent the extreme limits which shall determine suitability for use from all sources of supply. The gradation from any one source shall be reasonably uniform and not subject to the extreme percentages of gradation specified herein. For the purpose of determining the degree of uniformity, a fineness modulus determination shall be made upon representative samples, submitted by the contractor from such sources as he proposes to use. Fine aggregate from any one source having a variation in fineness modulus greater than 0.20 either way from the fineness modulus of the representative sample submitted by the contractor may be rejected.

Aggregates shall be stored in compartmented bins, or some positive means shall be used to prevent the inclusion of foreign material and segregation. The different kinds of aggregates, if stockpiled, shall be separated, and stockpiles of coarse aggregate shall be built up in successive horizontal layers not more than 3 feet thick. Each layer shall be completed before the next is started. Should segregation occur, the aggregate shall be remixed to conform to the grading requirements.

When ready-mixed concrete is used, stockpiles of acceptable aggregate shall be established at the plant supplying the concrete. It will not be permissible to use aggregate directly from the ready-mixed companies' stockpiles which are changing through the addition of daily production and withdrawal for commercial sales.

(1) **Fine Aggregate.** The fine aggregate for concrete shall consist of sand or a combination of sand and stone screenings conforming to the following requirements:

Sand shall consist of clean, hard, durable, uncoated grains, free from lumps, soft or flaky particles, organic matter, loam or other deleterious substances. Sand shall be free from salt and alkali and shall meet the requirements of A.A.S.H.O. T-104 for soundness.

The fine aggregate shall be well graded from fine to coarse and shall meet the requirements of Table "A" using A.A.S.H.O. Method T-27:



**TABLE "A"—GRADATION FOR STRUCTURES**

Passing $\frac{3}{8}$ inch sieve.....	100%
Passing 4 mesh sieve.....	95-100%
Passing 8 mesh sieve.....	65- 95%
Passing 16 mesh sieve.....	35- 80%
Passing 50 mesh sieve.....	5- 30%
Passing 100 mesh sieve.....	0- 10%
Weight removed by elutriation test, not more than.....	3%

**TABLE "B" GRADATION FOR PORTLAND CEMENT  
CONCRETE PAVEMENT**

Passing $\frac{3}{8}$ inch sieve.....	100%
Passing No. 4 mesh sieve.....	95-100%
Passing No. 8 mesh sieve.....	65- 95%
Passing No. 16 mesh sieve.....	35- 80%
Passing No. 50 mesh sieve.....	10- 30%
Passing No. 100 mesh sieve.....	2- 10%

Mortar specimens made with the fine aggregate shall have a compressive strength using A.A.S.H.O. Method T-71, at 28 days, of at least 90 percent of the strength of similar specimens made with Ottawa sand and having a fineness modulus of 2.40 (plus or minus 0.10).

**(2) Coarse Aggregate.** The coarse aggregate for all classes of concrete shall consist of broken stone or gravel conforming to the following requirements:

Coarse aggregates shall be furnished in two separate sizes. The No. 4 to 2" size separated at the 1 inch sieve, and the No. 4 to 1½" size separated at the  $\frac{3}{4}$  inch sieve. The aggregates shall be free from thin, elongated, laminated or coated particles, organic matter and other deleterious substances. Coarse aggregate, whether produced from rock or gravel, shall have a percent of wear not to exceed 35 at 500 revolutions as determined by A.A.S.H.O. Method T-96 (Los Angeles Rattler Test), and shall meet the requirements of A.A.S.H.O. T-104 for soundness.

Coarse aggregate shall be well graded, between the limits specified, and the size or sizes designated shall conform to the requirements of Table "A" when tested by means of laboratory screens:

TABLE "A"—GRADATION FOR STRUCTURES

Designated Sizes	Percentage by Weight Passing Laboratory Sieves Having Square Openings						
	2½	2	1½	1¼	1	¾	½
No. 4 to ½" .....						100	90-100
No. 4 to ¾" .....						100	40- 70
No. 4 to 1" .....					100	90-100	20- 55
No. 4 to 1½" .....			100		90-100	55- 85	25- 60
No. 4 to 2" .....		100	95-100	70- 95		35- 70	10- 30
No. 4 to 2" .....	100	95-100	60- 85		35- 70		10- 30
¾" to 1½" .....		100	90-100	50- 75	20- 55	0- 15	
1" to 2" .....	100	90-100	35- 70		0- 15		

No. 4      ¾"      ½"      No. 4

0-15      40- 70      20- 55      0-10

0-10      10- 30      0- 5      0- 5

TABLE "B"—GRADATION FOR PORTLAND CEMENT CONCRETE PAVEMENT

Passing	Percentage by Weight Passing Square Mesh A.A.S.H.O. T-27	
Note (1)	¾" to 1½"	No. 4 to ¾"
2 inch .....	100	
1½" .....	90-100	100
1" .....	20- 55	90-100
¾" .....	0- 15	40- 70
¾" .....		0- 10
No. 4 mesh .....		

**Note (1)** The coarse aggregate shall be furnished in two separate sizes with the separation at the  $\frac{3}{4}$  inch size.

It is the intent of these specifications that there shall be a portion of the material above the minimum shown in each designated size.

(Attention is called to the fact that the shape of aperture specified for determining compliance with specifications for size of coarse aggregate has no relation to the size or shape of aperture or type of screen used in the production of the material.)

**(d) Sampling Aggregates.** The fine and coarse aggregates shall be sampled in accordance with the method described in Method T-2 of the A.A.S.H.O.

**(e) Testing Concrete.** The concrete for test purposes shall be made with the fine and coarse aggregate and the cement proposed for use on the work, and the concrete shall be mixed to the same consistency as will be used in the construction. Test cylinders cast in the laboratory shall be made and cured in accordance with A.A.S.H.O. Method T-126 and cylinders made in the field shall be cast and cured in accordance with A.A.S.H.O. Method T-23. Testing of concrete cylinders shall be in accordance with A.A.S.H.O. Method T-22. The average of the strengths of three consecutive cylinders shall constitute a test.

**46.05 METHOD OF CONSTRUCTION.** (a) Falsework for supporting concrete work shall be built on foundations of sufficient strength to carry the loads without appreciable deformation. Falsework which cannot be founded on solid footings must be supported by ample falsework piling. Falsework shall be designed to carry the full loads coming upon it. All spans shall be given a temporary camber sufficient to allow for shrinkage and settlement. Bridges shall have a permanent camber only when shown on the plans. If appreciable settlement occurs in the falsework, the work shall be stopped, any masonry affected shall be removed and the falsework rebuilt. In general, double wedges or other suitable means shall be provided for constructing and maintaining falsework and forms to correct lines.

If requested by the engineer, detail drawings of the falsework shall be submitted to the engineer for approval, but such approval shall not operate to relieve the contractor of any of his responsibility under the contract for the successful completion of the improvement. Arch centering shall be so constructed as to permit of its being gradually and uniformly lowered or released after pouring the arch ribs or rings.

**.05 (b) Forms.** Forms shall be so designed and constructed that they may be removed without injury to the concrete.

Forms for all exposed concrete surfaces shall be made either of tongue-and-groove matched lumber of uniform width and thickness, surfaced inside to form a smooth and uniform surface, or shall be lined with plywood, using sheets of uni-

form size and thickness. Where forms are lined with plywood, all joints, holes, or other surface irregularities shall be filled with an approved joint filler and sanded to a smooth and uniform surface. For exposed concrete surfaces, only one type of form construction shall be used in any one form or forms for similar units of the structure. Undressed lumber may be used for backing or for surfaces which will not be exposed in the finished structure. All lumber shall be free from knot holes, loose knots, cracks, splits, warps or other defects affecting the strength or appearance of the finished structure. Form lumber shall be free from bulge or warp, and shall be thoroughly cleaned if used a second time. Forms for re-entrant angles shall be chambered and forms for edges shall be filleted unless otherwise required by plans or engineer.

In designing forms and centering, the concrete shall be treated as a liquid weighing 150 pounds per cubic foot for vertical loads, and not less than 85 pounds per cubic foot for horizontal pressure. The unsupported length of wooden columns and compression members shall not exceed 30 times the diameter or least side.

The forms shall be so designed that portions where finishing is required may be removed without disturbing portions of forms which are to be removed later and, as far as practicable, so that form marks will conform to the general lines of the structure. Column form marks shall be vertical and symmetrically placed.

When possible, forms shall be daylighted at intervals not greater than 10 feet vertically, the openings being sufficient to permit free access to the forms for the purpose of inspecting, working and spading the concrete.

All forms shall be set and maintained true to line and grade until the concrete is sufficiently hardened. The interior surfaces of forms shall be adequately oiled to insure non-adhesion of mortar. The forms shall be mortar-tight, and if necessary to close cracks due to shrinkage shall be thoroughly soaked with water. Forms shall remain in place for periods which shall be determined as hereinafter specified. When forms appear to be unsatisfactory in any way, either before or during the placing of concrete, the engineer shall order the work stopped until the defects have been corrected. Immediately before placing concrete, all extraneous material within the forms shall be removed. For narrow walls and columns, where the bottom of the form is inaccessible, clean-out ports shall be provided at the top surface of concrete where a stoppage of placing occurs.

Metal ties or anchorages within the forms shall be so constructed as to permit their removal to a depth of at least 2 inches from the face without injury to the concrete. All fittings for metal ties shall be of such design that, upon their removal, the cavities which are left will be of the smallest possible size.



**0.5 (c) Handling, Measuring and Batching Materials.** Concrete of the classes indicated shall be made up of acceptable material batched in the proportions set by the engineer for the specific materials. Corrections necessitated by variations in the moisture content of the component materials or for other similar reasons shall be made as directed by the engineer, based upon laboratory determinations.

The contractor shall handle and measure the fine aggregate and the two sizes of coarse aggregate separately. No batch shall be run requiring fractional bags of cement.

Cement shall be measured by the bag as packed by the manufacturer.

Water shall be measured either by volume or by weight. The allowable error in accuracy of water measuring equipment on the mixer shall not be more than 2 percent. The equipment should preferably include an auxiliary tank from which the measuring tank shall be filled, and in any case shall be so arranged that the accuracy of measurement will not be affected by variations in pressure in the water supply line.

**0.5 (d) Equipment for Weighing Aggregates.** The weighing methods shall be approved by the engineer prior to the beginning of the batching operations, and the weighing equipment shall conform to the following requirements:

The capacity of the weighing equipment shall be adequate to permit the required weighing of materials without delaying the production of the mixer. The scales, that is the balance or weighing mechanism, shall be of the beam or springless dial type and shall be the product of an established manufacturer. Unless the scale is equipped with a multiple weigh beam which permits the weighing of more than one kind of material on the same scale without changing the settings on the weigh beams, separate scale units shall be furnished for each kind of material to be weighed. Scales shall be so designed and built that they may be maintained within a maximum tolerance of 1 percent of the net load being weighed.

The value of the minimum graduation shall not be greater than 2 pounds for scales of 2,000-pound and less capacity, or greater than 5 pounds for scales over 2,000-pound capacity.

Scales of the suspended hopper type shall be equipped with a telltale dial or similar device for indicating to the scale operator that the required load in the weighing container is being approached. Such device shall indicate at least the last 50 pounds of load.

Each scale's installation shall be provided with standard 50-pound test weights which shall be subject to such tests as the engineer deems necessary in order to determine their accuracy. The minimum number of test weights required shall be of a weight equivalent to 10 percent of the net load capacity of the scales to the nearest greater 50 pounds, but in no case less than two test weights.



**.05 (e) Consistency.** Concrete shall have a consistency such that it will be workable in the required position. It shall be of such consistency that it will flow around reinforcing steel but individual particles of the coarse aggregate when insulated shall show a coating of mortar containing its proportionate amount of sand. The consistency of concrete shall be gauged by the ability of the equipment to properly place it and not by the difficulty in mixing or transporting. In all cases the amount of water used shall be the minimum necessary to secure the desired workability of the concrete, within the ranges of slump specified. The quantity of the mixing water shall be determined by the engineer in accordance with the provisions of Article 46.03 and shall not be varied without his consent.

**.05 (f) Mixing. (1) Mixing at Site.** The concrete shall be mixed only in such quantities as are required for immediate use. No retempering of the concrete will be allowed. Aggregates or bags of cement containing lumps or crusts of hardened material shall not be used.

Concrete shall be thoroughly mixed in a batch mixer of approved type and capacity for a period of not less than one and one-half minutes after all materials, including water, are in the drum.

During such period, the drum shall be operated at drum speeds specified by the mixer manufacturer and shown on his nameplate on the machine. The entire contents of the mixer shall be removed from the drum before materials for the succeeding batch are placed therein and the mixer preferably shall be equipped with mechanical means for preventing the addition of aggregates after mixing has commenced.

The mixer shall be equipped with an approved timing device which will automatically lock the discharging device so as to prevent the emptying of the mixer until the materials have been mixed the minimum specified time. No mixer shall be operated above its rated capacity and no mixer shall be used which has a rated capacity of less than one-bag batch.

The first batch of concrete material placed in the mixer shall contain an additional quantity of sand, cement and water sufficient to coat the inside surface of the drum without diminishing the mortar content of the mix. Upon the cessation of mixing for any considerable length of time, the mixer shall be thoroughly cleaned.

Hand mixing will not be permitted, except in case of emergency and under written permission from the engineer. When permitted, it shall be done only on water-tight platforms. The sand shall be spread evenly over the platform and the cement spread upon it. The sand and cement shall then be thoroughly mixed while dry by means of shovels until the mixture is of a uniform color, after which it shall be formed into a "crater" and water added in an amount necessary to produce mortar of the proper consistency. The material upon the outer portion of the "crater" ring shall then be shoveled to the center and the entire mass turned and sliced until a

uniform consistency is procured. The coarse aggregate shall then be thoroughly wetted and added to the mortar and the entire mass turned and returned at least six (6) times and until all the stone particles are thoroughly covered with mortar and the mixture is of a uniform color and appearance. Hand mixed batches shall not exceed one-half ( $\frac{1}{2}$ ) cubic yard in volume. Hand mixing will not be permitted for concrete to be placed under water.

**(2) Ready Mixed.** Materials for ready-mixed concrete shall be handled, measured, and batched in compliance with the requirements for site-mixed concrete.

Plant capacity and transportation equipment shall be sufficient to insure continuous delivery at the rate required. The rate of delivery of concrete during concreting operations shall be such as to provide for the proper handling, placing, and finishing of the concrete. The interval between batches shall not exceed twenty (20) minutes. The methods of delivery and handling concrete shall be such as will facilitate placing with a minimum of rehandling and without damage to the structure of the concrete.

No mixed or agitated concrete shall be used which has remained in the drum of the truck agitator or truck mixer more than ten (10) minutes without mechanical agitation.

The method and time of delivery shall be controlled by plant slips issued to the driver and signed by the authorized representative of the engineer at the plant. This slip shall contain the name and location of the plant, the size and proportion of the batch, the time the vehicle left the plant, and the recording of the revolution counter. Upon arrival, the slip shall be delivered to the inspector or engineer at the site of the work.

The concrete as delivered to the forms shall retain three (3) to five (5) percent entrained-air as determined by standard tests for air content, A.A.S.H.O. Methods T-121 or T-152.

**(a) Central Plant Mixing.** Concrete may be mixed at a central plant. When mixed at a central plant, the mixer and methods used shall be in accordance with the requirements of "Mixing at Site" and those contained in the following provisions:

The minimum mixing time shall be one and one-half ( $\frac{1}{2}$ ) minutes for mixers up to one (1) cubic yard capacity with an increase of fifteen (15) seconds mixing time for each cubic yard or fraction thereof of additional capacity.

Mixed concrete shall be transported from the central mixing plant to the site of the work in agitator trucks of approved design. Unless otherwise permitted in writing by the engineer, the agitator shall be a closed water-tight revolving drum. It shall be suitably mounted and shall be capable of transporting and discharging the concrete without segregation. The agitating speed of the drum shall be not less than two (2) nor more than six (6) revolutions per minute. The

volume of mixed concrete permitted in the drum shall not exceed the manufacturer's rating nor exceed eighty (80) percent of the gross volume of the drum.

Concrete transported in agitator trucks shall be discharged at the job and placed in its final position in the forms within one and one-half ( $1\frac{1}{2}$ ) hours after the introduction of mixing water, except that when the temperature is eighty-five (85) degrees F. or above, the concrete shall be placed in its final position in the forms within one (1) hour after the introduction of the mixing water.

**(b) Truck Mixing.** Concrete shall be mixed in a truck mixer of approved design. Truck mixing shall be in accordance with the following provisions:

Unless otherwise permitted in writing by the engineer, the truck mixer shall be a closed, water-tight, revolving drum. It shall be suitably mounted and shall be fitted with blades capable of combining all ingredients into a thoroughly mixed and uniform mass and of discharging the concrete without segregation.

The mixing speed of the drum shall be not less than four (4) nor more than fifteen (15) revolutions per minute. The agitating speed of the drum shall be not less than two (2) nor more than six (6) revolutions per minute.

The volume of mixed concrete permitted in the drum of truck mixers shall not exceed the manufacturer's rating on the capacity plate nor fifty (50) percent of the gross volume of the drum in the case of top-door-loading truck mixers nor fifty-seven and one-half ( $57\frac{1}{2}$ ) percent in the case of end-loading truck mixers.

Each truck mixer shall be equipped with an approved device for registering the number of revolutions made by the drum during the interval between introduction of water into the drum and discharge of concrete from the mixer. The drum shall revolve continuously during this interval.

When truck mixers are used, a water-measuring device shall be provided to measure accurately the quantity of water for each batch. The device shall be mounted on the truck mixer or located at the point of taking on the water. The device shall permit ready access and ready determination of the amount of water used.

When wash water is used as a portion of the mixing water for the succeeding batch, it shall be accurately measured and taken into account in determining the amount of additional mixing water required. When wash water is carried on the truck mixer, it shall be carried in a compartment separate from that used for carrying or measuring the mixing water.

**WATER INTRODUCED AT PLANT.** When water, cement and aggregates are introduced into a truck-mixer drum at the loading plant, the drum shall revolve continuously until the concrete is discharged therefrom. Mixing shall commence immediately after the introduction of water and shall continue for at least fifty (50) revolutions of the drum at mixing

speed. Not more than one-hundred (100) revolutions of the drum shall be at a speed in excess of six (6) revolutions per minute. Any other revolutions shall be at agitating speed of not less than two (2) r.p.m. nor more than six (6) r.p.m.

The concrete shall be discharged at the job and placed in its final position in the forms within one and one-half (1½) hours after the introduction of the mixing water, except that when the temperature is eighty-five (85) degrees F. or above, the concrete shall be placed in its final position in the forms within one (1) hour after the introduction of the mixing water.

**WATER INTRODUCED IN TRANSIT.** The interval between the charging of the mixer drum with cement and aggregates and the introduction of the mixing water shall not exceed thirty (30) minutes.

Mixing shall commence immediately after the introduction of the mixing water and shall continue at mixing speed for at least fifty (50) revolutions of the drum. Not more than one-hundred (100) revolutions of the drum shall be at a speed in excess of six (6) r.p.m. Any other revolutions shall be at agitating speed of not less than two (2) r.p.m. nor more than six (6) r.p.m.

The time interval between introduction of water and final discharge of concrete from the truck mixer shall be as specified for "Water Introduced at Plant."

**WATER INTRODUCED AT SITE.** When water is to be introduced into the truck-mixer drum at the site of the concrete construction, the requirements above for "Water Introduced in Transit" shall govern.

**(c) Partial Mixing at the Central Plant.** Concrete may be partially mixed by central plant mixing for the purpose of shrinking the batch and the mixing completed by truck mixing.

The central plant mixing shall be in accordance with the requirements of Paragraph 46.05 (f) (1), "Mixing at Site" except that the mixing time at the central plant may be reduced to thirty (30) seconds. The truck mixing shall be in accordance with the requirements of Paragraph 46.05 (f) (2) (b), "Water Introduced at Plant" save that the volume of mixed concrete allowed in the drum shall not exceed sixty-six and two-thirds (66 2/3) percent of the gross volume of the drum.

**.05 (g) Placing Concrete.** Concrete shall then be placed in the forms immediately after mixing and in no case shall concrete be used which does not reach its final position in the forms within the time stipulated under Paragraph (f) above. The method of placing shall be such as to avoid segregation of the aggregates or displacement of reinforcement. During the placing of deck slab, curbs, and rail, the fresh concrete shall be protected from the direct rays of the sun and from the drying effects of the heat and wind.



Use of long chutes for conveying concrete from mixing plant to forms will not be permitted. Troughs, pipes or short chutes used as aids in placing concrete shall be arranged and used in such a manner that the ingredients of the concrete are not separated. Where steep slopes are required the chutes shall be equipped with baffle boards or be in short lengths that reverse the direction of movement. When pipes are used they shall be kept full of concrete and have their lower ends kept buried in fresh concrete in the same manner that a tremie is used. All chutes, troughs and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each run. Water used for flushing shall be discharged clear of the concrete in place. Open troughs and chutes shall be either of metal or metal lined and shall extend as nearly as possible to the point of deposit. When the discharge must be intermittent, a hopper or other device for regulating the discharge shall be provided.

Dropping the concrete a distance of more than five (5) feet or depositing a large quantity at any point and running or working it along the forms will not be permitted.

Placing of concrete shall be so regulated that the pressures caused by the wet concrete shall not exceed those used in the design of the forms.

Special care shall be taken to fill each part of the forms by depositing concrete directly as near final position as possible, to work the coarser aggregates back from the face and to force the concrete under and around the reinforcement bars without displacing them. The placing of concrete shall be done in such manner that the steel reinforcing is not coated with cement before its final embedment. In depositing concrete around steel shapes and closely spaced reinforcing bars the concrete shall be deposited on one side of the steel and worked until it flushes under the steel to the opposite side before any concrete is placed on the opposite side or over the steel. After the concrete has taken its initial set, care shall be exercised to avoid jarring the forms or placing any strain on the ends of projecting reinforcement.

Concrete shall be compacted by continuous working with suitable tools or suitable vibrating equipment in a manner acceptable to the engineer. All concrete, except that placed in handrails or curbs when poured as separate units, or that which is placed under water, shall be compacted by working with an internal vibratory tamper operating with a vibrating frequency of not less than forty-five-hundred (4,500) per minute, except that on structures involving less than fifty (50) cubic yards, the engineer may, at his discretion, waive this requirement. The vibrating element shall not be attached to, nor shall it be held against, the forms, reinforcing steel, or any embedded fixtures around which the concrete is being placed. The vibrator shall be so operated that it will not penetrate through the fresh concrete into any that is partially hardened. Vibration shall be supplemented by such



spading as is necessary to insure smooth surfaces and dense concrete, along form surfaces and in locations impossible to reach with vibrators.

Concrete shall be placed in each section of the work in continuous operation working day and night, if necessary to avoid stoppage planes. It shall be deposited in horizontal layers when practicable, placing thin layers at first that can be thoroughly worked into intimate contact with the concrete beneath. The depth of layers used shall be such that the succeeding layer will be placed before the previous layer has attained initial set. Each layer shall be compacted in a manner that will break up and obliterate any tendency to form a plane of separation between the layers. If it is necessary, by reason of an emergency, to stop placing concrete before any section is completed, bulkheads shall be placed as the engineer may direct. Any place where the placing of concrete is discontinued for a sufficient time to allow the concrete to take initial set shall be deemed a construction joint and treated as hereinafter described under "Construction Joints."

Horizontal layers so located as to produce a construction joint at a location wherein a "feather edge" might be produced in the succeeding layer, shall be formed by inset work so that the succeeding layer will end in a body of concrete having a thickness of not less than six (6) inches.

In no case shall the work on any section or layer be stopped or temporarily discontinued within eighteen (18) inches below the top of any face, unless the details of the work provide for a coping having a thickness of less than eighteen (18) inches, in which case, at the option of the engineer, the construction joint may be made at the under side of the coping.

The method and manner of placing concrete shall be so regulated as to place all construction joints across regions of low shearing stress and in such locations as will be hidden from view to the greatest possible extent. The method and sequence of placing concrete for the various types of concrete bridge construction shall be as specified below for the particular type of construction involved.

Concrete in girder haunches less than three (3) feet in height shall be placed at the same time as that in the girder stem and the column or abutment tops shall be cut back to form seats for the haunches. Whenever any haunch or fillet has a vertical height of three (3) feet or more, the abutment (or columns), the haunch and the girder shall be poured in three (3) successive stages; first, up to the lower edge of the haunch; second, to the lower side of the girder; and third, to completion.

The operation of placing concrete in floor slabs shall be continuous between construction and/or expansion joints. Joints shall be vertical, at right angles to the axis of the roadway, and over the center of a floorbeam or other support provided in the design.

The floors and girders of through girder superstructures shall be placed in one continuous operation unless otherwise specified, in which case special shear anchorage shall be provided to insure monolithic action between girder and floor.

**PLACING CONCRETE IN REINFORCED CONCRETE SLAB AND GIRDER BRIDGES.** Concrete preferably shall be deposited by beginning at the center of the span and working from the center towards the ends. Concrete in girders shall be deposited uniformly for the full length of the girder and brought up evenly in horizontal layers. Concrete in slab spans shall be placed in one continuous operation for each span.

**PLACING CONCRETE IN BEAMS.** Each beam, between the limits shown on the plans or directed by the engineer, shall be cast in one continuous operation. The top of the concrete shall be kept level and it shall be placed in layers, the thickness of which shall be proportioned to the rate of delivery of the concrete to the forms so that there will be no planes of initial set in any part of the unit. All keyways, seats for secondary beams, dowels and bars that connect the beams with other units of the work shall be in place before the placing of concrete is commenced.

Concrete in T-beam or deck girder spans shall be placed either in one continuous operation or in two separate operations, each of which shall be continuous; first to the top of the girder stems and, second, to completion. In the latter case, the bond between stem and slab shall be positive and mechanical and shall be secured by means of suitable shear keys with or without dowels in top of girder stem. The size and location of these keys and dowels shall be computed. In general, suitable keys may be formed by the use of timber blocks approximately two (2) inches by four (4) inches in cross section and having a length four (4) inches less than the width of the girder stem. These key blocks shall be placed along the girder stem as required but the spacing shall be not greater than one (1) foot center to center. The blocks shall be beveled and oiled in such manner as to insure their ready removal.

**PLACING CONCRETE IN CONCRETE VIADUCTS.** Concrete in columns shall be placed in one continuous operation, unless otherwise directed. Columns shall be allowed to set at least twelve (12) hours before the caps are placed. No concrete shall be placed in the superstructure until column forms have been stripped sufficiently to determine character of concrete in the columns. The load of the superstructure shall not be allowed to come upon the bents until they have been in place at least fourteen (14) days, unless otherwise permitted by the engineer.

**PLACING CONCRETE IN CONCRETE ARCHES.** The concrete in arch rings shall be placed in such manner as to load the centering symmetrically. The centering shall be weighted if necessary to prevent distortion. Arch rings shall be divided into sections of such size that when working simultaneously at points symmetrically located about the crown the sections can be cast in one continuous operation without permitting the formation of planes of initial set. The sections shall be bonded together by suitable keys or dowels. Arch rings may be cast in a single continuous operation when

specified on the plans or permitted by the engineer. The arrangement of sections shall be such as to avoid the creation of initial stresses in the reinforcement. Adequate struts shall be provided to resist any unbalanced thrusts to piers in structures composed of more than one span. The size, arrangement, and sequence of placing concrete for sections of all arches shall be subject to the approval of the engineer.

**.05 (h) Depositing Concrete Under Water.** Concrete shall not be exposed to the action of water before setting, or deposited in water, except with the approval of the engineer and under his immediate supervision. When concrete is so deposited, the method and manner of placing shall be as hereinafter designated.

All concrete deposited under water shall be mixed in the proportions designated for Class "S" concrete.

Concrete deposited under water shall be carefully placed in a compact mass in its final position by means of a tremie, a closed bottom dump bucket or other approved methods and shall not be disturbed after being deposited. Special care shall be exercised to maintain still water at the point of deposit. No concrete shall be placed in running water and all form work designed to retain concrete under water shall be water-tight. The method of depositing concrete shall be so regulated as to produce approximately horizontal surfaces. Each seal shall be placed in one continuous operation.

When a tremie is used it shall consist of a tube having a diameter of not less than ten (10) inches, constructed in sections having flanged couplings fitted with gaskets. The means of supporting the tremie shall be such as to permit free movement of the discharge end over the entire top of the work and to permit its being rapidly lowered when necessary to choke off or retard the flow. The discharge end shall be entirely sealed at all times and the tremie tube kept full to the bottom of the hopper. When a batch is dumped into the hopper the tremie shall be slightly raised, but not out of the concrete at the bottom, until the batch discharges to the bottom of the hopper. The flow is then stopped by lowering the tremie. The flow shall be continuous and in no case shall be interrupted until the work is completed.

When concrete is placed by means of a bottom dump bucket, the bucket shall have a capacity of not less than one-half ( $\frac{1}{2}$ ) cubic yard. The bucket shall be lowered gradually and carefully until it rests upon the concrete already placed. It shall then be raised very slowly during the discharge travel, the intent being to maintain, as nearly as possible, still water at the point of discharge and to avoid agitating the mixture.

**.05 (i) Construction Joints.** When the work of placing concrete is delayed until the concrete has taken initial set, the point of stopping shall be deemed a construction joint. The location of construction joints shall be planned in advance and shall be subject to approval by the engineer. The placing of concrete shall be carried continuously from joint to



joint. These joints shall then be perpendicular to the principal lines of stress and in general be located at points of minimum shear.

At all horizontal construction joints and at other locations, when directed, a gage strip not less than two (2) inches thick shall be placed inside the forms along all exposed faces to give the joints a straight line and eliminate wedge shape particles of concrete that might chip off. In placing concrete up to construction joints the forms shall be "over filled" at least one (1) inch and all excess material removed.

In joining fresh concrete to concrete that has already set, the forms shall be drawn tight against the face of the set concrete and all gage strips and key forms removed. The surface of the set concrete to be contacted shall then be cut over with suitable tools to remove all laitance, loose and foreign material. This surface shall then be washed and scrubbed with wire brooms, drenched with water until saturated and kept saturated until the new concrete is placed. Immediately prior to placing new concrete, the old surface shall be thoroughly coated with a very thin coating of neat cement mortar.

In order to bond successive courses, suitable keys shall be formed at the top of the upper layer of each day's work and at other levels where work is interrupted. These keys shall be formed by the insertion and subsequent removal of beveled wood strips which shall be thoroughly saturated with water prior to insertion. Rough stone or steel dowels may, at the discretion of the engineer, be used in lieu of keys. All construction joints shall be keyed or doweled as shown on the plans or directed by the engineer.

Sliding joints shall be true planes paralleled to the direction of movement. Where sliding joints are to be provided at the ends of slabs, girders or beams, or between walls, etc., the surface of the supporting concrete shall be given a smooth finish and covered with two (2) layers of three-ply roofing felt to separate the concrete.

Unless otherwise shown on the plans, expansion joints shall be filled with an approved premolded expansion joint filler. The thickness of the joints shall be one-fourth ( $\frac{1}{4}$ ) inch where the length of the moving concrete is twenty (20) feet or less, one-half ( $\frac{1}{2}$ ) inch for lengths twenty-one (21) to thirty-six (36) feet, and three-fourths ( $\frac{3}{4}$ ) inch for lengths of thirty-seven (37) to fifty (50) feet unless otherwise shown on the plans. The joint filler shall be cut to the same shape as the area to be covered with one-fourth ( $\frac{1}{4}$ ) inch smaller along all surfaces that will be exposed in the finished work. It shall be firmly fixed against the surface of the concrete already in place in such manner that it will not be displaced when the concrete is deposited against it. Where necessary to use more than one piece to cover any surface, the joint between the separate pieces shall be covered with a layer of two-ply roofing felt, one side of which shall be covered with hot asphalt to insure proper retention. The one-fourth ( $\frac{1}{4}$ )

inch space along the edges at exposed faces shall be filled with wooden strips of the same thickness as the joint material. These wooden strips shall be saturated with oil and have sufficient "draft" to make them readily removable after the concrete is placed. Immediately after the forms are removed the expansion joints shall be carefully inspected. Any concrete or mortar that has sealed across the joint shall be neatly cut and removed.

Special water-tight and flashed joints shall be constructed as shown on the plans.

**.05 (j) Cold Weather Concreting.** During freezing weather provision shall be made for heating the water, aggregates and concrete and the concrete shall be thoroughly protected until set. When concrete operations are carried on during freezing weather the aggregates shall be heated by either steam or dry heat to a temperature of not less than seventy (70) degrees F. and not more than one-hundred fifty (150) degrees F. The water shall be heated to a temperature between one-hundred-thirty (130) degrees F. and one-hundred-fifty (150) degrees F. The temperature of the mixed concrete shall be not less than sixty-five (65) degrees F. and not more than eighty-five (85) degrees F. at the time of placing it in the forms. Neither salt nor chemical admixtures shall be added to the concrete to prevent freezing.

The contractor shall assume all risk in connection with placing concrete in cold weather, and placing the concrete during freezing weather shall in no way relieve the contractor of responsibility for proper results. Should concrete placed under these conditions prove unsatisfactory it shall be removed and replaced at the contractor's expense.

When the low temperatures are expected to drop to or below freezing and/or the high temperatures of the day are expected to remain below forty (40) degrees F., the contractor shall furnish sufficient canvas and framework or other type of housing to enclose and protect the structure in such a way that the air surrounding the fresh concrete can be kept at a temperature not less than sixty (60) degrees F. for a period of seven (7) days after the concrete is placed. All heating of the air surrounding the concrete shall preferably be done with steam or hot water. At the close of the curing period, the heat may be reduced to such an extent that the temperature inside the housing shall not decrease faster than twenty (20) degrees per day until such time that the temperature inside the housing is the same as that outside. A sudden change of temperature shall be prevented. The seven (7) day curing period is based on the use of standard Portland Cement and a curing temperature of not less than sixty (60) degrees F. If high early strength concrete is used, or if the surrounding air temperature during the curing period is less than sixty (60) degrees F., the length of the curing period specified will be altered accordingly by the engineer.

In case of failure of the contractor to comply with any of the above provisions for curing and/or heating of concrete, the engineer will immediately notify the contractor to com-



ply with the required provisions as specified above. In the event the contractor fails to remedy the unsatisfactory condition within one (1) hour after issuance of such notice, the engineer will immediately proceed with the contractor's forces and equipment or any other available forces and/or equipment to cure and/or heat the concrete, as specified above, and the entire cost to the State of this work will be deducted from any money due the contractor.

**.05 (k) Curing Concrete.** Concrete surfaces exposed to conditions causing premature drying shall be protected by covering as soon as possible with canvas, burlap, sand or other satisfactory material and kept moist; or if the surfaces are not covered, they shall be kept moist by flushing or sprinkling. Curing shall continue for a period of not less than seven (7) days after placing the concrete. If High Early Strength cement is used this period may be reduced, as directed by the engineer. Other precautions to insure the development of strength shall be taken by the contractor as directed by the engineer.

Forms and existing concrete shall be kept continuously wet for a period of not less than one (1) hour before any concrete is placed therein and shall be kept wet until covered with concrete except that adequately oiled forms shall be thoroughly washed with a water spray immediately before the placing of concrete therein.

All forms for vertical surfaces shall be covered with burlap or an approved equivalent immediately upon completion of the placing of the concrete, and the cover material used shall be kept wet until the forms are removed.

Unless otherwise approved by the engineer, the curing of concrete shall be accomplished by either water curing or membrane curing as follows:

**(1) Water Curing.** All top surfaces of concrete shall be kept moist after finishing with a fine water spray until such a time as the concrete has set sufficiently to permit it to be covered with burlap or an approved equivalent. The temperature of the water used shall be as near as possible to that of the fresh concrete. The burlap shall be placed as close behind the finishers as possible without marring the finished surface and shall be kept wet for the entire curing period or in the case of concrete floors until removed.

As soon as practicable after the concrete floor has been placed, the burlap covering shall be removed, and the entire floor surface shall be covered with at least one and one-half (1½) inches of moist sand, which shall be kept wetted continuously for the curing period.

Forms shall be removed from all vertical surfaces as soon as the concrete has set sufficiently to permit their removal. The contractor shall then remove all surface irregularities and shall repair all depressions, voids, or holes, including holes formed by trapped air, all in accordance with the provisions of Paragraph .05 (l) below. The removal of forms

and the repair of surface irregularities shall be accomplished without interfering with any of the curing requirements. As soon as the vertical forms have been removed and the surface irregularities repaired, the concrete shall be completely covered with burlap or equivalent material, which shall be kept continuously wet for the balance of the curing period.

**(2) Impervious Membrane Curing.** The membrane curing compound shall comply with the requirements set forth in A.A.S.H.O. M-148 and shall be delivered to the job in the manufacturer's original container, clearly labeled to show the name of the manufacturer and the contents. The clear curing compound shall be sufficiently transparent and free from permanent color to result in no pronounced change in color from that of the natural concrete. The compound shall, however, contain a dye of color strength sufficient to render the film distinctly visible on the concrete for a period of at least four (4) hours after application.

The material shall be ready for use as shipped by the manufacturer and no diluting will be permitted. At least one pint sample of the membrane curing material shall be taken from each shipment and/or load, and no material shall be used prior to the written approval by the engineer.

The sealing solution shall be applied under pressure with a spray nozzle in such a manner as to cover the entire exposed surface thoroughly and completely with a uniform film at a rate of not less than one (1) gallon per one-hundred-fifty (150) square feet of concrete surface. Sufficient pressure shall be maintained in the spray machine to force the material to leave the nozzle in the form of a fine mist.

All concrete surface shall be kept moist with a fine water spray or with wetted burlap until such time as the sealing compound is applied.

The applicator shall keep close up to the finishers of the top surfaces of concrete at all times and spray all concrete immediately after the finishing operations are completed to the satisfaction of the engineer. No traffic of any sort, pedestrian or vehicular, will be permitted on the top surface of any concrete that has been sealed, for a period of not less than seven (7) days after placing, unless first covered with a layer of fine sand not less than one (1) inch thick. The sand shall not be placed for at least eight (8) hours after the final application of the sealing compound.

When concrete is cast in forms, such as walls, beams, columns, etc., it shall be kept continuously wet while in the forms, and during the stripping and surface repair operations. Forms shall be removed from all vertical surfaces as soon as the concrete has set sufficiently to permit their removal. The contractor shall then remove all surface irregularities and shall repair all depressions, voids, or holes, including holes formed by trapped air, all in accordance with the provisions of Paragraph .05 (1) below. As soon as the contractor has

removed all surface irregularities and repaired all depressions, voids, or holes, including those formed by trapped air, to the satisfaction of the engineer, the sealing compound shall be applied immediately before the surface has had an opportunity to dry out.

**.05 (1) Removal of Forms and Falsework.** In order to facilitate finishing, forms on ornamental work, railings, parapets and exposed vertical surfaces shall be removed in not less than twelve (12) or more than forty-eight (48) hours, depending upon weather conditions. Forms under slabs, beams, girders and arches shall remain in place at least fourteen (14) days in warm weather and in cold weather at the discretion of the engineer, except that forms for slabs having a span length of less than ten (10) feet may be removed at the end of seven (7) days. Forms shall always be removed from columns before removing shoring from beneath beams and girders in order to determine the conditions of concrete in the columns.

No forms whatever shall be removed at any time without the consent of the engineer. Such consent shall not relieve the contractor of responsibility for the safety of the work. Blocks and bracing shall be removed with the forms and in no case shall any portion of the wood forms be left in the concrete. Lips of mortar and all irregularities caused by form joints shall be removed. The presence of honeycomb areas may be considered sufficient cause for rejection of the structure, and upon written notice from the engineer the contractor shall remove and rebuild the structure in part or in whole as specified, at his own expense.

As soon as the forms are removed, all projecting wires, tie bolts or other metal devices used for holding the forms in place and which pass through the body of the concrete shall be cut back as specified under "Forms" above, and the holes or depressions thus made, and all other holes, depressions and small voids which show upon the removal of the forms, shall be repaired as follows: All coarse or broken material shall be chipped away until a dense uniform surface of concrete exposing solid coarse aggregate is obtained. Feather edges shall be cut away to form faces perpendicular to the surface being patched. All surfaces of the cavity shall be thoroughly saturated with water, after which a thin layer of neat cement mortar shall be applied. The cavity shall then be filled with a thick mortar mixed in the same proportion as that which was used in the body of the work and of the same temperature as the surface against which it is to be placed. The cement used in the patching mortar shall be a blend of Portland Cement and white Portland Cement properly proportioned so that the final color of the cured mortar will be the same as the color of the surrounding concrete. The mortar shall be thoroughly tamped into place and the surface floated with a wood float before initial set takes place. The patch shall then be cured as set forth for the concrete in Paragraph .05 (k) of this article.

For patching large or deep areas, coarse aggregate shall be added to the patching material and special precautions shall be taken to insure a dense, well bonded and properly cured patch, all as required by the engineer.

Falsework shall not be removed at any time without the consent of the engineer. Such consent shall not relieve the contractor of responsibility for the safety of the work. Falsework shall remain in place after concreting is completed at least fourteen (14) days in warm weather and in cold weather at the discretion of the engineer.

Falsework and centering for arches shall not be struck until the fill back of the abutments has been placed up to the spring line. Falsework for rigid frame structures shall not be removed until the fill has been placed back of the vertical legs.

The removal of the falsework will depend upon the results of tests when High Early Strength concrete is used, or when, in the opinion of the engineer, conditions warrant special tests for determining the strength of the concrete.

All falsework piling shall be pulled or cut off 1-foot below finished ground line where conditions will permit. If conditions are not favorable for pulling or cutting off the piles as stated above, the piles shall be either broken or shot off at the stream bed, unless otherwise provided by the engineer.

**.05 (m) Finishing Concrete.** All concrete surfaces exposed in the completed work shall comply with the requirements of ordinary finish as specified in Paragraph .05 (m) (1), except that the concrete deck slab and the concrete curb and sidewalk surfaces shall comply with the requirements of Paragraphs .05 (m) (2) and (3) below, respectively, except as otherwise provided or indicated on the plans or in the special provisions.

**(1) Ordinary Finish.** An "Ordinary Finish" is defined as the surface left by the removal of the forms with all holes left by form ties filled and all defects repaired. The surface shall be true and even, free from stone pockets, depressions or projections beyond the surface. All surfaces which cannot be repaired to the satisfaction of the engineer shall be given a "Rubbed Finish."

**(2) Concrete Floors.** Concrete floors shall be struck off with a template immediately after pouring to provide the proper crown and shall be finished to a smooth even surface by means of both longitudinal and transverse wooden floats, or other suitable means. The finished surface shall not show a variation of over one-eighth ( $\frac{1}{8}$ ) inch in ten (10) feet using a ten (10) foot straightedge placed parallel to the centerline of roadway. When a transversely-broomed finish is used, the allowable variations noted herein shall be independent of the depth of the broom marks. No variations will be permitted that will tend to prevent complete drainage on all parts of the deck. The surface shall be corrected by grinding



off the high spots, or other approved method, as may be required in order to conform to these limits. An edging tool shall be used at expansion joints not armored.

The concrete in bridge seats and tops of walls shall be brought flush with the finished top surface, struck off with a straightedge and floated.

**(3) Curbs and Sidewalk Surfaces.** Concrete curbs and sidewalks shall be finished in true surfaces having the lines and grades shown on the plans. Concrete shall be worked until the coarse aggregate is forced down into the body of the concrete so that no coarse aggregate is exposed. The surface shall then be floated with a wooden float to a smooth and uniform surface. When the concrete in the curb or sidewalk has hardened sufficiently, the surface shall be given a broom finish. The broom shall be of an approved type. The strokes shall be square across the curb or sidewalk from edge to edge with adjacent strokes overlapped and shall be made by drawing the broom without tearing the concrete, but so as to produce regular corrugations not over one-eighth ( $\frac{1}{8}$ ) inch in depth.

**(4) Rubbed Finish.** When the concrete has hardened before being rubbed the surface shall be thoroughly saturated with water and rubbed with a medium coarse carborundum stone, using a small amount of mortar on its face. The mortar shall be composed of cement and fine sand mixed in the proportions used in the concrete being rubbed. When forms can be removed while the concrete is still green the surface shall be wetted and rubbed with a wooden float. If permitted by the engineer, a thin mortar proportioned as outlined above may be used in the rubbing.

Rubbing shall be continued until all form marks, projections and irregularities have been removed, all voids filled and a uniform surface has been obtained. The paste produced by this rubbing shall be kept moist and allowed to set for at least five (5) days. The surface shall then be smoothed by rubbing with a fine carborundum stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform color. After the final rubbing is completed and the surface has dried, it shall be rubbed with burlap to remove loose powder and shall be left free from all unsound patches, paste, powder and objectionable marks.

**(5) Special Tooled Finish.** Special tooled finish shall be produced with a bush-hammer, a pick, a crandall or other tool approved for this purpose. Air tools, preferably, shall be used. No tooling shall be done until the concrete has set for at least fourteen (14) days and as much longer as may be necessary to prevent the aggregate particles from being "picked" out of the surface. The finished surface shall show a grouping of broken aggregate particles in a matrix of mortar, each aggregate particle being in slight relief.



**.05 (n) Drainage and Weep Holes.** Drainage and weep holes shall be constructed in the manner and where indicated on the plans or directed by the engineer. Drains and weep holes in the face of the abutments shall be connected with the roadway drains wherever indicated on the plans. Ports or vents for equalizing hydrostatic pressure shall be placed below low water. Weep holes shall be placed at the elevations shown or directed.

Forms for weep holes through concrete may be clay pipe, concrete drain pipe, or wooden boxes. If wooden forms are used they shall be removed after the concrete is placed. Where weep holes pass through stone masonry the outlet through the masonry shall be rectangular in shape, from two (2) to three (3) inches in width and from six (6) to eight (8) inches in height. Drain pipes embedded in concrete shall be standard light weight cast-iron water pipe or wrought iron pipe.

No direct compensation will be allowed for drainage and weep holes and incidental work in connection therewith. The cost shall be considered as included in the unit prices bid for the various classes of concrete. No deduction will be made in the volume of concrete or masonry for the space occupied by drains and weep holes.

**.05 (o) Pipes, Conduits and Ducts.** Pipes, conduits and ducts which are to be encased in the concrete, shall be installed by the contractor as the concrete is being placed. They shall be rigidly held against displacement during the placing of the concrete.

No direct compensation will be allowed for furnishing and installing all pipes and conduits shown on the plans. The cost of furnishing, installing and incidental work in connection therewith shall be considered as included in the unit prices bid for the various classes of concrete. No deduction will be made in the volume of concrete for the space occupied by pipes, conduits and ducts.

**.05 (p) Defective Work.** Any defective work discovered shall be removed immediately and renewed. If the surface of the concrete is bulged, uneven, or shows honeycombing which, in the opinion of the engineer, cannot be repaired satisfactorily, the entire section shall be removed and renewed. No compensation will be allowed for this work.

**46.06 PREFORMED EXPANSION JOINT FILLERS FOR CONCRETE.** Preformed expansion joint fillers shall comply with the requirements set forth in A.A.S.H.O. Designation M-153, and, unless otherwise indicated on the plans, the contractor shall furnish material conforming to Type I or Type II.

**46.07 METHOD OF MEASUREMENT.** The yardage to be paid for shall be the number of cubic yards of concrete of the several classes, complete in place and accepted. In computing the concrete yardage for payment, the dimensions used shall be those shown on plans or ordered in writing by the

engineer. The quantity of concrete involved in fillets, scorings and chamfers two (2) square inches or less in cross-sectional area shall be neglected. No deduction shall be made for the volume of concrete displaced by reinforcing steel, expansion joint material, drainage and weep holes, or pipes, conduits and ducts embedded in concrete. Deduction shall be made for the volume of timber piles, concrete piles, or structural steel, including steel piling but not including expansion joint material, incased in concrete. The volume of timber piles encased in concrete shall be assumed as 0.8 cubic foot per linear foot of pile. No measurements or other allowances will be made for forms, falsework, cofferdams, pumping, bracing, etc.

The yardage shall not include any yardage of concrete contained in any other item when the said other item provides that its pay name be compensation for any concrete involved.

**46.08 BASIS OF PAYMENT.** The yardage, determined as provided above, shall be paid for at the contract unit price bid per cubic yard for "Class 'A,' Class 'AD,' Class 'B' Class 'D,' Class 'DD,' or Class 'S' Concrete" as the case may be, which price and payment shall be full compensation for the concrete, for all materials, including expansion joint filler, water-stops, weep holes, pipes and conduits indicated on the plans, and for installation of all joints, weep holes, drains, pipes and conduits and for all timber bumpers, forms, falsework, placing and finishing, and for all labor, equipment, tools and incidentals necessary to complete the item, but shall not constitute payment for reinforcing steel, which will be paid for as a separate item.

Item Number	Item Description	Unit
4610	Class "A" Concrete	Cubic Yard
4611	Class "A" Concrete	Lump Sum
4612	Class "AD" Concrete	Cubic Yard
4613	Class "AD" Concrete	Lump Sum
4614	Class "B" Concrete	Cubic Yard
4615	Class "B" Concrete	Lump Sum
4616	Class "D" Concrete	Cubic Yard
4617	Class "D" Concrete	Lump Sum
4618	Class "DD" Concrete	Cubic Yard
4619	Class "DD" Concrete	Lump Sum
4620	Class "S" Concrete	Cubic Yard
4621	Class "S" Concrete	Lump Sum

## SUBSECTION 46.10 CLASS "F" CONCRETE

**46.11 DESCRIPTION.** This item shall consist of either plain or reinforced Portland Cement concrete prepared and constructed in accordance with this specification at the locations and of the form and dimensions shown on the plans, or current standard drawings or as directed by the engineer.

**46.12 MATERIALS.** (a) **Concrete.** The concrete shall consist of one (1) part of Portland Cement conforming to A.A.S.H.O. Specification M-85, two (2) parts of clean, hard, sharp, well-graded sand that will pass a one-fourth ( $\frac{1}{4}$ ) inch screen, and four (4) parts of broken stone or gravel, free from clay, loam or organic matter, that will pass a one and one-half ( $1\frac{1}{2}$ ) inch screen and be retained on a one-fourth ( $\frac{1}{4}$ ) inch screen. Measurements shall be by volume. Water used in concrete shall be free from sewage, oil, acid, strong alkalies or vegetable matter, and also shall be free from clay or loam. The total amount of water used, including that on the surface of the aggregate, shall not exceed six (6) gallons per sack of cement. All materials shall be satisfactory to the engineer. All aggregates shall be approved by the engineer before use. Aggregates shall be uniformly graded.

(b) **Forms.** Forms, when necessary, shall be of suitable material and strength and so constructed that the finished concrete shall be of the form and dimensions shown on the plans. The forms shall be constructed true to line and grade, and shall be mortar tight and sufficiently rigid to prevent displacement and sagging between supports. Material and work shall be satisfactory to the engineer.

(c) **Reinforcing Steel.** Concrete reinforcing bars, when required, shall meet the requirements of A.A.S.H.O. Specification M-31 and shall be of the grade of plain or deformed bars as indicated on the plans or as called for in the proposal.

**46.13 CONSTRUCTION METHODS.** Concrete shall be thoroughly mixed in such a manner as to positively insure a uniform distribution of the materials throughout the mass. Batches shall be proportioned on the basis of integral sacks of cement.

Concrete shall be mixed only in such quantities as are required for immediate use and shall be used while fresh before initial set has taken place. Any concrete in which initial set has begun shall be wasted and not used in the work and in no case will retempering of concrete be allowed.

Concrete shall be thoroughly tamped into the forms, or into the cavity in which it will be used, and shall be well spaded and consolidated around fittings and embedded items. All reinforcement and other embedded items shall be accurately placed as shown on the plans and shall be firmly held in position during concreting. All such material shall be thoroughly clean and free from coating, rust, scale, oil or any foreign matter. Holes shall be wet before pouring concrete.

Exposed surfaces of concrete shall be protected from premature drying by means satisfactory to the engineer.

**46.14 MEASUREMENT AND PAYMENT.** Class "F" concrete shall not be measured for direct payment. Performance of this work is not payable directly, but shall be considered as a subsidiary obligation of the contractor, covered under the contract unit price for the individual work involved.

The term "Class 'F' Concrete" shall be so interpreted as to include all materials, forms, steel, labor and any other costs involved in the completion of the item.



**SECTION 47**

**REINFORCING STEEL**



**47.01 DESCRIPTION.** "Reinforcing Steel" shall consist of furnishing and placing reinforcing steel or wire fabric of the quality, type and size designated, in conformity with the plans, or as ordered in writing by the engineer, and in accordance with this specification. The use of cold twisted bars will not be permitted. Wire fabric shall be used only when specified and shall be of the type shown on the plans and approved by the engineer.

**47.02 MATERIAL.** Reinforcing steel shall meet the requirements of the standard specifications for billet steel concrete reinforcement bars of intermediate grade, A.S.T.M. Serial Designation A-15, unless otherwise specified. All bars shall be of the deformed type conforming to A.S.T.M. Serial Designation A-305, unless otherwise specified.

Where purchased from warehouse in small lots, reinforcing may, at the direction of the engineer, be accepted subject to the bending test. Bend test specimens for plain and deformed bars shall be taken from the finished bars, and shall be of the full thickness or diameter of bars as rolled, except that the specimens for deformed bars may be machined for a length of nine (9) inches, if deemed necessary by the manufacturer to obtain uniform cross-sections.

The test specimen shall bend cold around a pin without cracking on the outside of the bent portion as follows:

### BEND TEST REQUIREMENTS

Thickness or Diameter of Bars	Type of Bar Deformed Bars
Under No. 6 (nominal diameter $\frac{3}{4}$ " )	180 degrees d - 6t
No. 6 or over	90 degrees c - 6t
d=the diameter of pin about which specimen is bent.	
t=the thickness or diameter of the specimen.	

Wire and wire fabric, when used for reinforcement in concrete, shall conform to A.S.T.M. Specification A-82 for wire fabric. The type of fabric shall be approved by the engineer.

**47.03 PROTECTION OF MATERIAL.** Steel reinforcement shall be protected at all times from injury. When placed in the work, it shall be free from dirt, detrimental scale, paint, oil or other foreign substance. However, when steel has, on its surface, detrimental rust, loose scale and dust which is easily removable, it may be cleaned by a satisfactory method, if approved by the engineer.



**47.04 FABRICATION.** Bent bar reinforcement shall be cold bent to the shapes shown on the plans, and unless otherwise provided on the plans or by authorization, bends shall be made in accordance with the following requirements:

Stirrups and tie bars shall be bent around a pin having a diameter not less than two (2) times the minimum thickness of the bar. Bends for other bars shall be made around a pin having a diameter not less than six (6) times the minimum thickness except for bars larger than one (1) inch, in which case the bends shall be made around a pin of eight (8) bar diameters.

Bar reinforcement shall be shipped in standard bundles, tagged and marked in accordance with the code of standard practice of the concrete reinforcement steel institute.

When bar-bending diagrams are not shown on the contract plans, detail plans showing the bending of reinforcing bars shall be submitted to the engineer for approval.

**47.05 PLACING AND FASTENING.** All steel reinforcement shall be accurately placed in the positions shown on the plans and firmly held during the placing and setting of the concrete. Bars shall be tied at all intersections except where spacing is less than one (1) foot in each direction when alternate intersections shall be tied.

Distances from the forms shall be maintained by means of stays, blocks, ties, hangers, or other approved supports. Blocks for holding reinforcement from contact with the forms shall be precast mortar blocks of approved shape and dimensions or approved metal chairs. Layers of bars shall be separated by precast mortar blocks or by other equally suitable devices. The use of pebbles, pieces of broken stone or brick, metal pipe and wooden blocks shall not be permitted. Reinforcement in any member shall be placed and then inspected and approved by the engineer before the placing of concrete begins. Concrete placed in violation of this provision may be rejected and removal required.

If fabric reinforcement is shipped in rolls, it shall be straightened into flat sheets before being placed.

**47.06 SPLICING REINFORCEMENT.** All reinforcement shall be furnished in the full lengths indicated on the plans. Splicing of bars, except where shown on the plans, will not be permitted without the written approval of the engineer. Splices shall be staggered as far as possible.

Unless otherwise shown on the plans, bars in the bottom of beams and girders, and in wall, columns and haunches shall be lapped twenty (20) diameters and bars near the top of beams and girders having more than twelve (12) inches of concrete under the bars shall be lapped thirty-five (35) diameters, to make the splice.

**47.07 METHOD OF MEASUREMENT.** The poundage to be paid for shall be the calculated theoretical weight of the steel as shown on the plans or as ordered in writing by the engineer, complete in place, and accepted. The weights of standard sizes of reinforcing bars, conforming to A.S.T.M. 305, shall be computed in accordance with the following table:

No. 3 Bars.....	.376 Lbs. Per Foot
No. 4 Bars.....	.668 Lbs. Per Foot
No. 5 Bars.....	1.043 Lbs. Per Foot
No. 6 Bars.....	1.502 Lbs. Per Foot
No. 7 Bars.....	2.044 Lbs. Per Foot
No. 8 Bars.....	2.670 Lbs. Per Foot
No. 9 Bars.....	3.400 Lbs. Per Foot
No. 10 Bars.....	4.303 Lbs. Per Foot
No. 11 Bars.....	5.313 Lbs. Per Foot

If reinforcing bars, other than standard sizes, or wire fabric are required, the unit weight will be shown on the plans.

**47.08 BASIS OF PAYMENT.** The poundage, determined as provided above, shall be paid for at the contract unit price bid for reinforcing steel complete in place, which price shall be full compensation for furnishing the material, all equipment, tools, labor and incidentals necessary to complete the item. No allowance will be made for the clips, wire separators, or other material used for fastening or supporting the reinforcing steel in place.

Item Number	Item Description	Unit
4710	Reinforcing Steel	Pound



**SECTION 48**

**STRUCTURAL STEEL**



**48.01 DESCRIPTION.** "Structural Steel" shall consist of furnishing, fabricating and erecting all structural steel shapes, plates, rivets and all other metal parts not included for payment under some other contract item, all erected in conformity with the plans or as directed in writing by the engineer. Furnishing and fabricating shall include delivery of the shop painted materials to the site of the work as shown on the plans, free of charge. Erecting shall include furnishing and applying field paint, unless otherwise specified.

**48.02 MATERIAL.** Structural steel, including eyebar, rivet steels, and special alloy steels, shall conform to the requirements of A.S.T.M. standard specifications as designated in the following table. Unless otherwise specified on the plans or in the special provisions, structural carbon steel shall be used where structural steel is specified, and structural rivet steel for all rivets.

Type	A.S.T.M. Designation
Structural carbon and eyebar steel.....	A-7
Structural weldable steel.....	A-373
Structural rivet steel.....	A-141
High-strength structural rivet steel.....	A-195
Structural silicon steel.....	A-94
Low-alloy structural steel.....	A-242
Structural nickel steel.....	A-8

Alloy steels shall be plainly marked at frequent intervals for identification. These marks shall be made during or immediately after rolling, shall be of such nature and spacing that they will be visible on practically all pieces during fabrication, and shall be visible after shop and field paints have been applied.

**48.03 METHOD OF CONSTRUCTION.** All structural steel shall be fabricated, erected and painted as set forth on the plans and as specified in Section 42, "Steel Bridges."

**48.04 MILL AND SHOP INSPECTION.** (a) **Notice of Beginning of Work.** The contractor shall give the engineer ample notice of the beginning of work at the mill or in the shop, so that inspection may be provided. The term "mill" means any rolling mill or foundry where material for the work is to be manufactured. No material shall be manufactured or work done in the shop before the engineer has been so notified.

(b) **Facilities for Inspection.** The contractor shall furnish facilities for the inspection of material and workmanship in the mill and shop, and the inspectors shall be allowed free access to the necessary parts of the work.

(c) **Inspector's Authority.** The inspector shall have the authority to reject any material or work which does not meet the requirements of these specifications. In case of dispute, the contractor may appeal to the engineer, whose decision shall be final.

(d) **Mill Orders and Shipping Statements.** The contractor shall furnish the engineer with as many copies of mill orders and shipping statements as the engineer may direct. The weights of the individual members shall be shown on the statements.

(e) **Facilities for Testing.** The contractor shall furnish test specimens, as specified herein, without extra charge; also the labor, testing machines and tools necessary to make the specimens and full-size tests.

(f) **Rejections.** The acceptance of any material or finished members by the inspector shall not be a bar to their subsequent rejection, if found defective. Rejected material and workmanship shall be replaced promptly or made good by the contractor.

**48.05 METHOD OF MEASUREMENT.** The poundage to be paid for shall be the number of pounds of structural steel of the type or types specified in the fabricated structure including field rivets shipped, but not in excess of the number of field rivets specified under Paragraph 42.05 (16), Section 42. The weight of erection bolts, field paint, boxes, crates and other containers used for packing and materials used for supporting members during transportation shall not be included.

The weights paid for shall be calculated on the basis of the following assumptions: (a) Unit weights, pounds per cubic foot:

Aluminum, cast or wrought.....	173.0
Bronze, cast .....	536.0
Copper-alloy .....	536.0
Copper sheet .....	558.0
Iron, cast .....	445.0
Iron, malleable .....	470.0
Iron, wrought .....	487.0
Lead, sheet .....	707.0
Steel, rolled, cast, copper bearing, silicon, nickel and stainless.....	490.0
Zinc .....	450.0

(b) The weights of rolled shapes and of plates up to and including thirty-six (36) inches in width shall be computed on the basis of their nominal weights and dimensions as



shown on the approved shop drawings. To the nominal weights of plates more than thirty-six (36) inches in width, there shall be added one-half ( $\frac{1}{2}$ ) of the allowed percentage of overrun in weight as tabulated in A.S.T.M. Specification A-6, "General Requirements for Delivery of Rolled Steel

Plates, Shapes and Bars for Structural Use," current edition. The weight will be computed on the basis of rectangular dimensions for all plates and over-all lengths for all structural shapes and with no deductions for copes, clips, sheared edges, punchings, borings, milling or planing, provided, however, that when parts can be economically cut in multiples from material of larger dimension, the calculated weight shall be taken as that of the material from which the parts can be cut.

(c) The weight of shop rivets shall be computed on the basis of reasonable average lengths, in accordance with the following table:

Rivets $\frac{1}{2}$ " in diameter.....	20 pounds per 100 rivets
Rivets $\frac{5}{8}$ " in diameter.....	30 pounds per 100 rivets
Rivets $\frac{3}{4}$ " in diameter.....	50 pounds per 100 rivets
Rivets $\frac{7}{8}$ " in diameter.....	100 pounds per 100 rivets
Rivets 1" in diameter.....	150 pounds per 100 rivets
Rivets $1\frac{1}{8}$ " in diameter.....	250 pounds per 100 rivets
Rivets $1\frac{1}{4}$ " in diameter.....	325 pounds per 100 rivets

(d) Field rivets and bolts shall be paid for on the basis of their computed weight.

(e) To the computed weight of metals may be added 0.4 of 1 percent as an allowance for shop paint.

(f) The weight of weld metal shall be computed on the basis of the theoretical volume of the dimensions of the welds. To this weight shall be added fifty (50) percent allowance for overrun.

**48.06 BASIS OF PAYMENT.** The poundage, determined as provided above, shall be paid for at the contract unit price per pound for structural steel of the type or types specified, which price and payment shall constitute full compensation for furnishing, fabricating, delivering, erecting ready for use, and painting all the steel and other metal, and for all labor, equipment, tools and incidentals necessary to complete the item.

Item Number	Item Description	Unit
4810	Structural Steel	Pound
4811	Structural Steel	Lump Sum



## SECTION 49

### BEARING AND EXPANSION PLATES



**49.01 DESCRIPTION.** "Bearing and Expansion Plates," conforming to these specifications, of the sizes and dimensions shown on the plans, shall be furnished and placed as called for on the plans or as directed by the engineer.

**49.02 MATERIAL.** (a) Bronze bearing and expansion plates shall conform to the specification for bronze castings for turntables and moveable bridges and for bearing and expansion plates of fixed bridges of the A.S.T.M. B-22. Alloy "B" shall be furnished unless other specified.

(b) Rolled copper-alloy bearing and expansion plates shall conform to the specification for rolled copper-alloy bearing and expansion plates for bridges and other structural uses of the A.S.T.M. B-100. Alloy No. 1 shall be furnished unless otherwise specified.

**49.03 METHOD OF CONSTRUCTION.** Bearing plates shall be accurately set in correct position as shown on the plans and shall have uniform bearing over the total area. They shall be securely anchored to the concrete with bolts set in the concrete of the size and as shown on the plans. Sliding surfaces shall be planed parallel to the movement of the spans and polished and shall be thoroughly coated with graphite and grease just before being placed in position, and special care shall be taken to avoid placing concrete in such a manner as to interfere with their free action.

**49.04 METHOD OF MEASUREMENT.** The weight of bronze bearing plates shall be computed from the dimensions as shown on the plans. The weight of bronze shall be assumed to be five-hundred-thirty-six (536) pounds per cubic foot.

**49.05 BASIS OF PAYMENT.** Payment will be made at the contract unit price bid per pound for bronze bearing plates complete in place, which price will be full compensation for furnishing material including bolts, all equipment, tools, labor, and incidentals necessary to complete the item.

Item Number	Item Description	Unit
4910	Bronze Bearing Plates	Pound
4911	Bronze Bearing Plates	Lump Sum



## SECTION 50

### ROCKERS AND BEARING PLATES



**50.01 DESCRIPTION.** "Rockers and Bearing Plates," conforming to these specifications, of the sizes, and dimensions shown on the plans, shall be furnished and placed as called for on the plans or as directed by the engineer.

**50.02 MATERIAL.** Steel castings shall conform to the specifications for mild to medium-strength, carbon-steel castings for general application, of A.S.T.M. Serial Designation A-27, supplemented by the following: Unless otherwise specified, all castings shall be Grade 65-35.

**50.03 METHOD OF CONSTRUCTION.** Rockers and bearing plates shall be accurately set and shall have uniform bearing over the total area. For a description of the method to be followed in setting bearing plates see Section 42, "Steel Bridges." Rockers shall not be permanently set until after the bridge floor has been placed and then only after making due allowance for temperature.

**50.04 METHOD OF MEASUREMENT.** The weight of castings shall be computed from the dimensions shown on the approved shop drawings, with an addition of five (5) percent for fillets and overrun. The weight of cast steel shall be assumed to be four-hundred-ninety (490) pounds per cubic foot.

**50.05 BASIS OF PAYMENT.** Unless designated as a separate item in the proposal, payment for castings will be made at the unit price bid for structural steel in place. When designated as a separate item in the bid schedule, cast steel will be paid for at the unit price bid complete in place. Price and payment as outlined herein shall constitute full compensation for furnishing materials, and all labor, equipment, tools and incidentals necessary to complete the item.

Item Number	Item Description	Unit
5010	Cast Steel	Pound
5011	Cast Steel	Lump Sum





## SECTION 51

### TREATED AND UNTREATED TIMBER



**51.01 DESCRIPTION.** "Treated and Untreated Timber" shall consist of structural timber of the grades, sizes, and dimensions specified, treated or untreated as called for, furnished in conformity with the plans and special provisions, or as ordered in writing by the engineer, and in accordance with this specification.

**51.02 MATERIAL. (a) General.** Unless otherwise specified, timber or lumber shall be standard sawn intermountain Douglas fir (*Pseudotsuga taxifolia*), western larch (*Larix occidentalis*), Pacific Coast Douglas fir (*Pseudotsuga taxifolia*), or any equivalent product. All lumber shall be furnished rough unless otherwise specified.

**(b) Grades.** Structural timber shall be stress graded, for the grade selected, in accordance with grading rules which conform to the basic provisions of the "American Lumber Standards."

The numerical stress values of structural timber and lumber set forth on the plans or in the special provisions are based on stress graded material meeting the requirements of grading rules developed, for the indicated stress, from the A.S.T.M. Specification "Methods for Establishing structural Grades for Lumber," Designation D245-49T.

Commercial stress grades of timber and lumber with grade descriptions providing material which will meet the stress requirements under rules developed from the A.S.T.M. D245-49T Specification, will be acceptable under the contract.

Only pieces consisting of sound wood, free from any form of decay, are acceptable, unless otherwise specified.

When untreated timber is specified, it shall show not less than eighty-five (85) percent heartwood on the girth, measured at the point where the least amount of heartwood occurs on any girth. When treated timber is specified, there will be no heartwood requirements and the amount of sapwood will not be limited.

**(c) Incising.** All lumber treated with creosote, creosote coal-tar solution or five (5) percent solution of pentachlorophenol, whose least dimension is two (2) inches or over, shall be incised in a suitable power-driven machine. Lumber having a thickness of three (3) inches and over shall be incised on all four (4) sides. Lumber less than three (3) inches thick shall be incised on the wide faces only, except where indicated on the drawings. The spacing and shape of the cutting teeth and the method of incising shall be such as to produce a uniform penetration. The depth of the incisions shall be not less than the following:

Size	Minimum Depth of Incision
2 x 12.....	3/8"
3 x 12.....	7/16"
4 x 12.....	1/2"
8 x 10.....	9/16"
10 x 12.....	5/8"
12 x 12.....	3/4"

Intermediate sizes in proportion.

**51.03 INSPECTION.** Each shipment of lumber to be treated shall be inspected at the treating plant, both before and after treatment, by an inspector designated by the engineer. The inspector shall stamp the ends of each accepted piece with a suitable stamp which has been copyrighted by him, of which a true impression has been filed with the Commission. The inspector also shall file with the Commission an itemized report of all timber inspected, giving temperatures, amount of preservative, time of treatment, lengths and sizes of timbers, total footage, and other pertinent information. Treated timber which does not bear, in legible form, the stamp of the inspector shall not be shipped from the treating plant.

Each shipment of untreated lumber shall be inspected at its source by an inspector designated by the engineer, insofar as is economically practical. In cases where the engineer deems inspection impractical, the material may be covered by a "Certificate of Inspection" from the Pacific Lumber Inspection Bureau, the West Coast Lumbermen's Association or the Western Pine Association, as designated.

The acceptance of any material or finished members by the inspector shall not be a bar to their subsequent rejection, if found defective. Rejected material and workmanship shall be replaced promptly or made good by the contractor.

**51.04 TREATED TIMBER.** Treated timber shall be interpreted to mean timber treated by a pressure method to retain at least the minimum quantity per cubic foot of the preservative treatment stipulated in the table below. All treated timber, except piling, shall be treated with either creosote oil, creosote coal-tar solution, or a five (5) percent solution of pentachlorophenol, unless otherwise specified. All treated timber piles shall be treated with either creosote oil or creosote coal-tar solution, unless otherwise specified.

**CREOSOTE, CREOSOTE COAL-TAR SOLUTION, CREOSOTE PETROLEUM SOLUTION, OR A 5% SOLUTION OF PENTACHLOROPHENOL**

<b>MATERIAL</b>	<b>Minimum net retention of preservative per cubic foot of wood</b>
Structural Timber— 5 inches or less in thickness	10 lbs. empty cell
Structural Timber— more than 5 inches in thickness	8 lbs. empty cell
Timber Piles	10 lbs. empty cell

<b>SALTS TREATMENT</b>	<b>Pounds Dry Salt per Cubic Foot</b>
Ammonical copper arsenite (Chemonite)	0.50
Chromated zinc chloride	1.15
Wolman salts (Tanalith)	0.55

Treatment of guide posts and guard rail posts shall be accomplished in such a manner and with such preservatives that will result in a surface to which paint will readily adhere without discoloration. The minimum depth of penetration shall be one-half ( $\frac{1}{2}$ ) inch.

**51.05 TIMBER PRESERVATIVES.** These specifications cover the type and quality of materials used in the preservative treatment of timber. Materials include the following:

Creosote oil

Creosote coal-tar solution

Creosote petroleum solution

5% solution of pentachlorophenol

Ammonical copper arsenite (Chemonite)

Chromated zinc chloride

Wolman salts (Tanalith)

(a) All preservatives shall conform to the specification for timber preservatives, A.A.S.H.O. Serial Designation M-133.

(b) Method of Sampling and Testing. Methods of sampling and testing shall conform to A.A.S.H.O. Serial Designation M-133.

(c) The use of all water-borne preservatives shall be subject to the limitations given in Paragraph 6.1.3 of the Interim Federal Specifications TT-W-00571 (d).

**51.06 METHOD OF MEASUREMENT.** Unless otherwise provided, treated timber and untreated timber, complete in place according to the plans and these specifications, will be measured separately by the thousand feet board measure. Measurements will be computed from the dimensions shown on the plans, unless changes in such dimensions have been authorized by the engineer. Standard timber sizes and lengths will be used in computations. This measurement will include only such timber as is a part of the completed and accepted work, and will not include timber used for erection purposes, such as falsework, forms bracing, sheeting, etc.

**51.07 BASIS OF PAYMENT.** The quantities, determined as provided above, shall be paid for at the contract unit prices per thousand feet board measure, (M. b. m.) for "Untreated Timber" or "Treated Timber" as the case may be, which prices and payments shall constitute full compensation for procuring, furnishing, and delivering all lumber and timber, for any preservative treatment required, for all hardware, and all other metal parts used in the item, for preparing, framing, assembling, erecting, and painting, and for all labor, equipment, tools and incidentals necessary to complete the item.

Timber bumpers at the end of concrete floor slabs shall be considered an incidental part of the work paid for under Subsection 46.00, "Portland Cement Concrete."

Timber trusses shall be paid for at the price bid per span complete, as specified under Section 43, "Timber Structures."

Item No.	Item Description	Unit
5110	Untreated Timber	M.b.m.
5111	Furnish Untreated Timber	M.b.m.
5112	Install Untreated Timber	M.b.m.
5120	Treated Timber	M.b.m.
5121	Furnish Treated Timber	M.b.m.
5122	Install Treated Timber	M.b.m.







## SECTION 52

### PILING



**52.01 DESCRIPTION.** "Piling" shall consist of furnishing and placing piling in conformity with the plans and these specifications or as ordered in writing by the engineer. Foundation, trestle and sheet piles shall be untreated timber, treated timber, concrete or structural steel, all as shown on the plans and called for in the bid schedule. No alternate types or kinds of piling, save such as are shown on the plans or as called for in these specifications, shall be used.

**52.02 REQUIREMENTS FOR ALL PILING.** Piling shall be designed to sustain the total pressure which may be transmitted to the foundation. Piles shall be spaced not closer than 2 feet 6 inches center to center unless they rest on a hard stratum and act as columns. The distance from the side of any pile to the nearest edge of the footing shall not be less than 9 inches. In general, piles shall be used only in places where a minimum penetration of 10 feet in firm material, or 20 feet in soft material, can be obtained. For foundations of arch, continuous span, or movable bridges, or high abutments the piles shall be completely embedded in firm earth, sand, or gravel which will afford good lateral support. When this result is impracticable, the soft material, shall be excavated from the pit and replaced by heavy riprap, for such distance and depth as the plans indicate or the engineer directs.

In general, all excavations of the foundation in which piles are to be driven shall be complete before driving is commenced. After driving is completed all loose and displaced materials shall be removed from around the piles, leaving a clean, solid surface to receive the concrete.

When subject to transverse forces, batter piles shall be driven in sufficient numbers to resist the transverse forces without assistance from the vertical piles.

Unless otherwise specified on the plans or in the special provisions, the contractor shall be responsible for determining the length of all piles except timber trestle piles. Piles for timber trestles shall be of the lengths shown on the plans and called for in the bid schedule, unless otherwise ordered in writing by the engineer.

The work shall be subject, at all times, to inspection by the engineer. The acceptance of any material or finished members by the inspector shall not be a bar to their subsequent rejection, if found defective. Rejected material and workmanship shall be replaced promptly or made good by the contractor.

**52.03 TIMBER PILING. (a) Description.** Timber piles shall consist of round or square timber of the kind and dimensions specified, driven in the location and to the elevations shown on the plans or as directed by the engineer, and in conformity with these specifications.

**(b) General.** Timber which will be below water level at all times may be of any species of wood which will satisfactorily withstand driving.

In untreated piling for use in exposed work, the diameter of the heartwood at the butt shall be not less than  $\frac{8}{10}$  of the required diameter of the pile. For treated piles, Douglas fir, southern yellow pine, or western larch timber shall be used. Treating may be done with either creosote or creosote coal-tar solution. Piles shall be treated according to current A.W.P.A. standard specifications for preservative treatment by pressure process, for a net retention of preservative of not less than that set forth under Section 51 "Treated and Untreated Timber."

The penetration of preservative, as determined by borings made at any point on the pile, shall be full depth of the sapwood and not less than  $\frac{1}{2}$  inch for all piles except Douglas fir. Douglas fir piles shall be so treated to obtain a minimum of  $\frac{3}{4}$  inch penetration of preservative. All holes made for determining penetration shall be filled with tight fitting treated plugs.

**(c) Quality.** All piling shall be cut from sound trees and shall be free from any defects which might impair their strength or durability. At least 9 inches of heartwood shall show on the butt. Piling shall contain no unsound knots. Sound knots will be permitted provided the diameter of the knot does not exceed 4 inches or one-third of the diameter of the stick at the point where it occurs. Any defects or combination of defects which will impair the strength or durability of the pile more than the maximum allowable knot shall not be permitted. Piles shall be cut above the ground swell and shall have a uniform taper from butt to tip. A line drawn from the center of the tip to the center of the butt shall not lie further from the center of the pile at any point than 1 percent of the length of the pile. Piles with short or reverse bends or kinks shall not be accepted. Piles with spiral grain which makes one complete turn in 50 feet or less shall not be accepted.

Unless otherwise specified, all piles shall be peeled by removing all of the rough bark and at least 80 percent of the inner bark. No strip of bark remaining on the stick shall be over  $\frac{3}{4}$  inch wide and there shall be at least 1 inch of clean wood surface between any two such strips. No less than 80 percent of the surface on any circumference shall be clean wood. All knots shall be trimmed close to the body of the pile. The butts shall be sawed square and the tips shall be sawed square or tapered to a point not less than 4 inches in diameter, as directed by the engineer.

**(d) Inspection.** Untreated timber piles shall be inspected at the site of the work by the engineer.

Treated timber piles shall be inspected at the creosoting plant before treatment for grade and suitability by an inspector designated by the engineer. The inspector shall stamp each pile on the butt end with a stamp which will make an impression that is readily legible after treatment. The stamp shall be copyrighted by the inspector and a true impression

filed with the Commission. After treatment the piles shall again be inspected by the inspector, who shall stamp each pile on the butt end with a stamp differing from that used before treatment, and of which a true impression has also been filed with the Commission. The inspector shall file with the Commission an itemized report of all piles inspected, giving temperatures, amount of preservative, time of treatment, lengths and sizes, total footage, and any other pertinent information. Treated timber piles which do not bear, in legible form, the stamps of the inspector made both before and after treatment shall not be shipped from the creosoting plant.

(e) **Dimensions.** Round piles shall have a minimum diameter at the tip, measured under the bark, as follows:

Length of Pile	Tip Diameter
Less than 40 feet.....	8 inches
40 to 60 feet.....	7 inches
Over 60 feet.....	6 inches

The minimum diameter of piles at a section 3 feet from the butt, measured under the bark, shall be as follows:

Length of Pile	Western Larch—Douglas Fir Southern Yellow Pine	All Other Species
20 feet and under.....	11 inches	11 inches
21 to 30 feet.....	12 inches	12 inches
31 to 40 feet.....	12 inches	13 inches
Over 40 feet.....	13 inches	14 inches

The diameter of the piles at the butt shall not exceed 20 inches. Square piles shall have the dimensions shown on the plans.

(f) **Methods of Construction.** The tops of all piles shall be sawed to a true plane as shown on the plans, and at the elevation fixed by the engineer. Piles which support timber caps or grillage shall be sawed to conform to the plane of the bottom of the super-imposed structure. In general, the length of pile above the elevation of cut-off shall be sufficient to permit the complete removal of all material injured by driving, but piling driven to very nearly the cut-off elevation shall be carefully freed of all splintered or otherwise injured material.



In timber trestle construction, the piles for any one bent shall be carefully selected as to size to avoid undue bending or distortion of sway bracing. However, care shall be exercised in the distribution of piles of varying sizes to secure uniform strength and rigidity in the bents for any given structure.

Collars or bands to protect timber piles against splitting and brooming shall be provided where necessary.

Timber piles shall be pointed where soil conditions require it. When necessary, the piles shall be shod with metal shoes as shown on the plans or of a design satisfactory to the engineer, the points of the piles being carefully shaped to secure an even and uniform bearing on the shoes.

**52.04 CONCRETE PILING. (a) Description.** Concrete piles shall be made in accordance with these specifications and the designs shown on the plans. They shall be placed in accordance with these specifications in the location and to the elevation shown on the plans or as directed by the engineer.

**(b) Material.** All concrete materials and their preparation and placing shall be in accordance with the requirements for Class "AD" concrete, as set forth in Subsection 46.00, and an air-entraining agent shall be added.

Reinforcement shall conform to the requirements for reinforcing steel of these specifications and the size and length shall be as shown on the plans.

Where waterproofing is to be used, special specifications will be given and the work shall be in accordance therewith.

**(c) Method of Construction.** Precast piles shall be made in accordance with the plans, and reinforcements shall be accurately placed and rigidly secured in such manner as to insure its proper location in the completed pile. Special reinforcement at the top and bottom to protect them from damage in driving shall be provided. The centers of the main reinforcing bars shall be not closer to the surface of the concrete than  $2\frac{1}{2}$  inches. The concrete shall be carefully placed, tamped, and spaded, care being taken to fill every part of the form and to work the concrete around and under the reinforcement without displacing it. The piles shall be cast separately, or, if alternate piles are cast in a tier, the intermediate piles shall not be poured until four (4) days after pouring the adjacent piles. Piles cast in tiers shall be separated by tar paper carefully placed. The concrete shall be placed continuously in each pile. The completed piles must be free from stone pockets, porous spots, or other defects, and be straight and true to the form specified. The forms shall be true to line, built of surfaced lumber and a 1 inch chamfer strip shall be used in all right-angle corners; they shall be water-tight and shall not be removed within twenty-four (24) hours after the concrete is placed. All exposed surfaces of the pile shall be given a rubbed finish. The piles shall be cured at least forty (40) days at a temperature of not less than 40 degrees F., or 28 days at a temperature of not less

than 60 degrees F., except that if high-early-strength cement is used, the curing time may be reduced to 7 days, under temperature not less than 60 degrees F. Piles shall not be driven until this curing time is completed. When concrete piles are lifted or moved they shall be supported at the quarter points and they shall be so designed that the unit stresses produced by handling, as described above, will not exceed 650 pounds per square inch compression in concrete nor 12,000 pounds per square inch tension in steel.

**(d) Piles Cast in Place.** Piles shall be constructed in accordance with details shown on the plans.

At all times prior to the placing of concrete in the driven shells, the contractor shall have available a suitable light for the inspection of each shell throughout its length. Any improperly driven, broken or otherwise defective shell shall be corrected to the satisfaction of the engineer, by removal and replacement, or the driving of an additional pile, at no extra cost to the State.

Accumulations of water in the shells shall be removed before the concrete is placed. No concrete shall be placed until all driving within a radius of 15 feet has been completed, nor until all the shells for any one bent have been completely driven. If this cannot be done, all driving within the above limits shall be discontinued until the concrete in the last pile cast has set at least seven (7) days.

**52.05 STRUCTURAL STEEL PILES.** Structural steel piles shall be rolled steel sections of the weight and shape called for on the plans. They shall be structural steel meeting the requirements for "Steel for Bridges," A.S.T.M. Designation A7. Piles bent or otherwise injured will be rejected.

**52.06 DRIVING (a) Untreated Timber.** Timber piles shall be driven with a gravity hammer, steam hammer or a combination of water jets and hammer.

Gravity hammers for driving timber piles shall weigh not less than 3,000 pounds and in no case shall the weight of the hammer be less than the combined weight of driving head and pile. The fall shall be so regulated as to avoid injury to the piles and in no case shall exceed 15 feet. When a steam hammer is used, the total energy developed by the hammer shall be not less than 6,000 foot pounds per blow.

Pile driver leads shall be constructed in such a manner as to afford freedom of movement to the hammer and they shall be held in position by guys or stiff braces to insure support to the pile during driving. Except where piles are driven through water, the leads preferably shall be of sufficient length so that the use of a follower will not be necessary.

Water jets may be used in combination with a hammer. The volume and pressure of the water at the jet nozzle, and the number of jets used, shall be sufficient to freely erode the material adjacent to the pile. If water jets and a hammer are used for driving, the jets shall be withdrawn and the

piles shall be driven by the hammer to secure the final penetration. This procedure may be varied if the desired results are not obtained.

Piles shall be driven strictly in accordance with the lines and spacing shown on the plans, and not more than  $\frac{1}{4}$  inch variation per foot from the vertical or from the batter line will be allowed. Unless otherwise ordered in writing by the engineer, timber piling shall be driven to a minimum bearing value of 20 tons, but in no case less than the design loads shown on the plans. In the absence of loading tests, the safe bearing values shall be determined by the following formulae:

$$\text{For single acting steam hammers} \dots\dots\dots P = \frac{2 W H}{S + 0.1}$$

$$\text{For double acting steam hammers} \dots\dots\dots P = \frac{2H (W + Ap)}{S + 0.1}$$

$$\text{For gravity hammers} \dots\dots\dots P = \frac{2 W H}{S + 0.1}$$

Where P=safe load per pile in pounds,

W=weight in pounds of striking part of hammer,

H=height of fall in feet,

A=area of piston in square inches,

p=steam pressure in pounds per sq. inch at hammer,

S=the average penetration in inches per blow for the last 10 to 20 blows for steam hammers, or of 5 to 10 blows for gravity hammers.

These formulas are applicable only when:

- (a) The hammer has a free fall.
- (b) The penetration is at a reasonably quick and uniform rate.
- (c) There is no sensible bounce after the blow. Twice the height of the bounce shall be deducted from "H" to determine its true value in the formula.
- (d) The head of the pile is not broomed or crushed.
- (e) A follower is not used.

**(b) Treated Timber.** Driving of treated timber piling shall be identical with that prescribed for untreated timber piling, with the following additional requirements applying to treated timber piling:

Treated piles and timbers shall be carefully handled without sudden dropping, breaking of outer fibers, bruising or penetrating the surface with tools. They shall be handled with rope slings. Cant dogs, hooks, or pike poles shall not be used.

All places where the surface of treated piles or timbers is broken by cutting, boring, or otherwise, shall be thoroughly coated with hot creosote oil and then with a coating of hot

tar. Hot creosote oil shall be poured into the bolt holes before the insertion of the bolts in such a manner that the entire surface of the holes shall receive a coating of the oil.

**(c) Concrete Piles.** Unless otherwise provided, concrete piles shall be driven with a steam hammer which shall develop an energy per blow at each full stroke of the piston of not less than one foot-pound for each pound of weight driven. In no case shall the total energy developed by the hammer be less than 6,000 foot pounds per blow. If a gravity hammer is used, it shall have a weight not less than 50 percent of the weight of the pile, but in no case less than 3,000 pounds, and the drop of the hammer shall not exceed 8 feet.

In driving, the tops of the piles shall be protected by suitable cushions of wood, ropes or other material, so placed as to reduce the injury to the pile to a minimum. Metal shoes or points of an approved design shall be used when ordered by the engineer. Concrete piles shall be driven in accordance with the requirements of Paragraph (a) above to sustain safely the design loads shown on the plans.

**(d) Structural Steel Piles.** Steel piles shall be driven in accordance with the requirements of Paragraph (a) above to sustain safely the design loads shown on the plans. The heads shall be cut squarely and an approved cast or structural steel driving cap shall be provided to hold the axis of the pile in line with the axis of the hammer and to prevent deformation of flange or web.

**(e) Treatment of Pile Heads After Cut-Off.** After the necessary cutting has been done to receive the cap, the heads of all timber piles shall be given three (3) coats of hot creosote oil. Unless embedded in concrete, they shall then be covered with a coat of hot tar, over which will be placed a sheet of 22 gauge galvanized iron, or a sheet of pure zinc, aluminum, copper, or any other approved non-rusting material of equal thickness, or a covering may be built-up of alternate layers of hot tar and loose woven fabric, conforming to A.A.S.H.O. Designation M-117, using four (4) layers of tar and three (3) of fabric. The cover shall measure at least 6 inches more in each dimension than the diameter of the pile and shall be bent down over the pile and the edges fastened with large-headed nails. After the cover material is in place, the cap shall be placed and drift-pinned as specified in Section 43, "Timber Structures."

**(f) Modification of Spacing.** In case the above carrying capacity can not be obtained, plans showing the necessary modification of the design of the footings and the number and location of the piles required shall be furnished by the engineer.

**52.07 SPLICING OF PILES.** Full length piles shall always be used where practicable but if splices can not be avoided splicing shall be done according to methods shown on the plans or as directed by the engineer. When the splicing of steel piles or steel shells of special piles is done by welding the arc method shall be given preference.



Extensions, splices or build-ups on concrete piles, when necessary, shall be made as follows: After the driving is completed, the concrete at the end of the pile shall be cut away, leaving the reinforcing steel exposed for a length of 40 diameters. The final cut of the concrete shall be perpendicular to the axes of the pile. Reinforcement similar to that used in the pile shall be securely fastened to the projecting steel and the necessary form work shall be placed, care being taken to prevent leakage along the pile. Just prior to placing concrete the top of the pile shall be thoroughly wetted and covered with a thin coating of neat cement, retempered mortar or other suitable bonding material. The forms shall remain in place not less than 7 days and then shall be carefully removed and the entire exposed surface of the pile finished as above specified.

**52.08 LOADING TESTS.** If specified on the plans or in the special provisions, or if for any reason the engineer deems it advisable to make load tests on one or more piles, the contractor shall load the test piles with a test load equivalent to twice the bearing value to which the piling is to be driven as shown on the plans or specified. The loading platform shall be so constructed that the readings may be taken directly on the pile. Care shall be exercised in cutting off and capping the piling to insure an even bearing surface in a horizontal plane over the entire end of the piling. The loading platform shall be so constructed and the loading material shall be of such a character as to permit the load being evenly balanced and distributed over the bearing area of the piling.

In lieu of a loading platform, hydraulic jacks with suitable yokes and pressure gages may be used.

The pile shall first be loaded with 25 percent of the test load, this load being allowed to remain undisturbed for a period of 6 hours. The loading shall then be increased to 50 percent of the test load, after which a period of test of 12 hours shall be allowed before further loading. The remainder of the test load shall be applied half at a time with a period of 6 hours between loadings. The entire test shall be allowed to remain in place for a period of 48 hours, after which the test load shall be removed and the platform dismantled.

The permanent settlement shall not exceed  $\frac{1}{4}$  inch in 48 hours unless otherwise specified. If the permanent settlement exceeds  $\frac{1}{4}$  inch in 48 hours, the engineer may order the load reduced until the maximum load is determined which will not cause a settlement in excess of the allowable. In case the safe carrying capacity of any pile is found by test or by formula if not tested, to be less than the load that it was intended to carry, additional piles shall be driven until the load per pile to be borne is reduced to safe carrying capacity.

**52.09 TEST PILES.** For his information the contractor may drive such test piles as he may believe necessary, provided, however, that the number of test piles to be paid for as such shall not exceed the number of test piles authorized on the plans or ordered in writing by the engineer.



In all cases he shall furnish the piles and necessary equipment. The location and manner of driving of test piles shall be at the discretion of the contractor, save that the contractor shall cooperate with the engineer in facilitating the keeping of accurate records of driving and complete field data and, after he has finished with any individual test pile, shall drive such test pile to any deeper penetration that the engineer may order, and save that when so indicated on the plans, the location and manner of driving of test piles shall be as ordered by the engineer. Unless otherwise indicated on the plans, the test piles furnished shall be of sufficient length to permit driving to practical refusal and shall be of the same section and size required for piles in the structure.

**52.10 METHOD OF MEASUREMENT.** Untreated timber piles, treated timber piles, and concrete piles shall be paid for on the basis of the lineal feet of piling left in place in the completed and accepted structure, or at a unit price per pile, unless otherwise called for on the plans or in the special provisions.

Quantities used in payment for structural steel piles shall include the materials and work specified under "Steel Bearing Piles" and "Driving Steel Bearing Piles" as follows:

(a) **Steel Bearing Piles.** The quantity to be paid for shall be the number of pounds of structural steel in the steel bearing piles, and in the materials used in capping or splicing where same is specified, computed from the nominal weights of the specified sections. To this computed weight shall be added the weights of all welds incidental to the placing of caps or splicing where same are specified.

(b) **Driving Steel Bearing Piles.** The quantity to be paid for under this item shall be computed on the basis of the lineal feet of piling driven below the bottoms of the substructure units.

Test piles, whether or not utilized as service piles in the structure, shall not be included in the above.

The number of test piles to be paid for shall be the number of test piles driven as ordered, provided, however, that the number shall not exceed the number of test piles authorized on the plans or ordered in writing by the engineer.

The number of loading tests to be paid for shall be the number of loading tests made, completed and accepted.

The number of pile shoes to be paid for shall be the number of shoes of approved design ordered and used on accepted piles.

**52.11 BASIS OF PAYMENT.** Untreated timber piling, treated timber piling, and concrete piling shall be paid for at the unit price bid per pile, or at the unit price bid per lineal foot determined as provided above, as called for in the bid schedule, complete in place; where prices and payment shall constitute full compensation for all materials, labor, equipment, tools and incidentals necessary to complete the items unless otherwise provided for on the plans or in the special provisions.

Steel bearing piles shall be paid for at the unit price bid per pound for the quantity as determined above; which price and payment shall constitute full compensation for all materials delivered at the site and shall include all costs necessary and incidental to the cutting off of piles if required, and to the capping of same, where specified on the design plans.

Driving steel bearing piles shall be paid for at the unit price bid per lineal foot for the footage as determined above, which prices and payment shall constitute full compensation for all materials, labor, equipment, tools and incidentals necessary to complete the item.

Test piles, determined as provided above, shall be paid for at the price bid, which price and payment shall constitute full compensation for all materials, labor, equipment, tools and incidentals necessary to complete the item.

The number of loading test of piles determined as provided above shall be paid for at the contract unit price each for "Loading Test of Piles," which price and payment shall constitute full compensation for building the loading platform, procuring and placing the loading material, and removing and disposing of the platform and material, or for furnishing necessary equipment for other approved methods of testing, for making the test and for removing the equipment.

The number of pile shoes, determined as provided above, shall be paid for at the contract unit price each for "Pile Shoes," which price and payment shall constitute full compensation both for furnishing the shoes and for utilizing the same on piles as ordered.

Item No.	Item Description	Unit
5200	Prebored Holes for Piles	Lineal Foot
5202	Pile Shoes	Each
5210	Untreated Test Piles	Lump Sum
5211	Treated Test Piles	Lump Sum
5212	Loading Test Piles	Each
5215	Furnish Steel Bearing Piles	Pound
5216	Drive Steel Bearing Piles	Lineal Foot
5217	Steel Bearing Piles in Place	Lineal Foot
5220	15 foot Treated Timber Piles	Each
5221	20 foot Treated Timber Piles	Each
5222	25 foot Treated Timber Piles	Each
5223	30 foot Treated Timber Piles	Each
5224	35 foot Treated Timber Piles	Each
5225	40 foot Treated Timber Piles	Each
5226	45 foot Treated Timber Piles	Each
5227	50 foot Treated Timber Piles	Each
5228	55 foot Treated Timber Piles	Each
5229	60 foot Treated Timber Piles	Each
5230	65 foot Treated Timber Piles	Each
5231	Furnish Treated Timber Piles	Lineal Foot
5232	Drive Treated Timber Piles	Lineal Foot
5236	Furnish Untreated Timber Piles	Lineal Foot
5237	Drive Untreated Timber Piles	Lineal Foot
5238	Untreated Timber Piles in Place	Lineal Foot
5250	Furnish Precast Concrete Piles	Lineal Foot
5251	Drive Precast Concrete Piles	Lineal Foot
5252	20 foot Precast Concrete Piles	Each
5253	22 foot Precast Concrete Piles	Each
5254	24 foot Precast Concrete Piles	Each
5255	26 foot Precast Concrete Piles	Each
5256	28 foot Precast Concrete Piles	Each
5257	30 foot Precast Concrete Piles	Each
5258	32 foot Precast Concrete Piles	Each
5259	34 foot Precast Concrete Piles	Each
5260	36 foot Precast Concrete Piles	Each
5261	38 foot Precast Concrete Piles	Each
5262	40 foot Precast Concrete Piles	Each



SECTION 53  
RAILING  
AND  
MISCELLANEOUS STRUCTURE ITEMS



**53.01 DESCRIPTION.** This section shall pertain to the furnishing and installation of steel beam bridge rail, other types of railing, curbs, guard fences, water proofing and other miscellaneous items enumerated at the end of this section or which may be added thereto. Materials and procedures shall conform to the provisions of this or other pertinent sections of the specifications, to the plans or standard drawings or as may be especially provided or directed.

**53.02 MATERIAL. (1) Steel Beam Bridge Rail.** This item shall consist of rail units fabricated to develop continuous beam strength and installed in accordance with Drawing No. SBRR. The steel beam bridge rail shall be twelve (12) gage unless otherwise noted on the plans.

The rail unit shall consist of steel formed into a beam not less than twelve (12) inches wide and three (3) inches deep. The cross-section shall consist of two corrugations symmetrical about the horizontal axis, with the rounded faces toward traffic and the edges turned away from traffic. The edges and the center of the rail shall contact each post. Splices shall be bolted and lapped not less than twelve-and-one-half (12½) inches.

The rail unit shall be designed to meet the requirements of the following table:

Rail or Joint		Beam Strength*			
Minimum Gage	Tensile Strength (Pounds)	Traffic Face Up Load (Pounds)	Maximum Deflection (Inches)	Traffic Face Down Load (Pounds)	Maximum Deflection (Inches)
12	80,000	1500	2¾	1200	2¾
		2000	5½	1600	5½
10	100,000	2000	2¾	1600	2¾
		3000	5½	2400	5½

\*With the rail element freely supported on 12'0" clear span and the load applied through a 3" flat surface at the center of the span. When the joint is tested it shall be at the center of the span.

Steel beam bridge rail parts furnished under this specification shall be interchangeable with similar parts regardless of the source or manufacturer.

The rail units shall be formed from open hearth or electric furnace steel of not less than twelve (12) gage and conforming to Drawing No. SBRR. A test specimen of the rail material shall elongate not less than twelve (12) percent in a two (2) inch gage length.



The terminal section shall be formed from open hearth or electric furnace steel of not less than twelve (12) gage and conforming to Drawing No. SBBR. A test specimen of the material shall elongate not less than twelve (12) percent in a two (2) inch gage length.

All bolts and nuts shall conform to Drawing No. SBBR and shall be galvanized to conform to ASTM Specification A-153.

All metal parts which are not galvanized shall be thoroughly cleaned and shop painted with one (1) coat of a fast drying rust inhibitive primer. The primer shall be thoroughly dry with a tough and durable surface before the parts are handled or packed for shipment. Formulas used for primers shall have been demonstrated as capable of withstanding at least two-hundred (200) hours exposure in a weatherometer test conducted in accordance with "Recommended Practice for Light and Water Exposure Apparatus (Carbon Arc Type) for Testing Paint, Varnish, Lacquer and Related Products" ASTM D-822-46T with no evidence of cracking, blistering, rusting, checking, peeling, scaling or loss of adhesion.

**(2) Other Items.** Other items listed under this section shall be of the type of material prescribed in the special provisions, the plans, standard drawings or specified otherwise within the contract.

**53.03 CONSTRUCTION METHODS.** (1) Steel beam bridge rail shall be installed in accordance with provisions in the plans, as may be set forth in special provisions or as directed by the engineer.

**(2) Other Items.** Other items covered by this section shall be installed or constructed in accordance with pertinent plans, specifications, standard drawings, special provisions or as directed.

**53.04 METHODS OF MEASUREMENT.** (1) steel beam bridge rail shall be measured by the lineal foot, complete in place and accepted.

**(2) Other Items.** Other items covered by this section shall be measured as indicated by the list of items below or by the proposal.

**53.05 BASIS OF PAYMENT.** (1) Steel beam bridge rail shall be paid for at the unit price bid for the item which shall be full compensation for furnishing and installing the rail, including all materials, labor, tools, equipment and incidentals necessary to complete the work.

**(2) Other Items.** Other items covered by this section shall be paid for at the unit price bid for each item which shall be full compensation for furnishing and installing the item, including all materials, labor, tools, equipment and incidentals necessary to complete the work.

---

---

Item Number	Item Description	Unit
5310	Steel Beam Bridge Rail	Lineal Foot
5312	Steel Bridge Rail	Lineal Foot
5314	Pipe Rail	Lineal Foot
5316	Ornamental Rail	Lineal Foot
5318	Concrete Rail	Lineal Foot
5320	Concrete Curb and Rail	Lineal Foot
5322	Concrete Curb	Lineal Foot
5326	Guard Fence	Lineal Foot
5327	Corrugated Transite Sheets	Square Foot
5328	Galvanized Iron	Square Foot
5329	Galvanized Iron	Lump Sum
5330	Asphalt Plank	Square Foot
5331	Asphalt Plank	Lump Sum
5332	Waterproofing	Lump Sum
5333	Coal-Tar Waterproofing	Square Foot
5334	Drainage System	Lump Sum
5335	Transite Pipe	Lineal Foot

---

---



## SECTION 54

### PAINTS FOR WOOD AND METAL



**54.01 GENERAL REQUIREMENTS.** Paint shall consist of pigments of the specified composition ground to the required fineness in the specified vehicles, to which shall be added thinner and drier, as may be required in the specifications for each kind of paint. The paint shall not cake, liver, thicken, curdle, gel, or settle badly, shall be readily broken up with a paddle to a smooth uniformity of good brushing consistency, and shall dry to a uniform texture without streaking, running, or sagging when applied to a vertical surface.

When applied in a normal brushing coat under normal conditions of temperature and humidity, paint shall dry in not more than twenty-four (24) hours, unless otherwise specified in Article 54.05, "Materials."

**54.02 PACKING AND MARKING.** Paint shall be delivered in such containers as may be ordered. Each container shall bear a label with the following information shown thereon: Name and address of the manufacturer, shipping point, trademark or trade name, kind of paint, formula, number of gallons, date and lot number.

**54.03 PREPARATION OF SURFACE.** Steel and wood. All surfaces shall be thoroughly clean and dry before paint is applied. All scale and loose paint shall be removed. No painting shall be done under what the engineer judges to be adverse weather conditions. Surfaces being painted shall be at approximately the same as the atmospheric temperature. Each coat of paint shall be allowed to dry at least forty-eight (48) hours before the succeeding coat is applied. Prime coats may be applied at the mill or shop.

**54.04 SAMPLING AND TESTING.** No paints shall be used previous to the receipt of an acceptance and report from the laboratory.

Representative samples of paints or paint ingredients shall be taken at the point of delivery and submitted to the laboratory by the inspector.

Acceptance of paints or paint ingredients on the basis of a certified formula or analysis submitted by the manufacturer may be made at the discretion of the laboratory.

**54.05 MATERIALS.** All paints furnished shall conform with the specifications listed below:

**(1) PAINTS FOR METALS.**

**Material**

**AASHO**

- |  |       |
|--|-------|
| (a) Red Lead (Dry and Paste-in-Oil) and paint made therefrom   | M-71  |
| (b) Red Lead Ready-Mixed Paints, Type I, II, III & IV  | M-72  |
| (c) Zinc Chromate  | M-142 |
| (d) Aluminum Paint   | M-69  |
| (e) Black Bridge Paint   | M-68  |
| When two coats of black paint are specified, sufficient red lead shall be used to tint first coat, to distinguish it from second coat. |       |
| Lampblack used in a first field coat shall conform to ASTM-209.  |       |

**(2) PAINTS FOR WOOD.**

- |  |          |
|--|----------|
| (a) First Coat White (Prime)   |          |
| 100 pounds White Lead Paste (9% raw linseed oil)   |          |
| (Basic Sulfate   | M-123    |
| Basic carbonate,   | M-122    |
| or a mixture thereof)  |          |
| 5 gallons raw linseed oil  | M-125    |
| 2 gallons turpentine   | M-127    |
| 1 pint drier—ASTM D 600  |          |
| (b) Second Coat White (Body) and   |          |
| (c) Third Coat White (Finish) shall conform to AASHO M-70, Type 1, Class "A," or as an alternate, Federal Spec. TT-P-102, Class "A." |          |
| (d) Black Paint  |          |
| 20 pounds lampblack paste (containing not more than 75% linseed oil)   | ASTM-209 |
| 4½ gallons of raw linseed oil  |          |
| 2 quarts of turpentine   |          |
| 1 pint of drier.   |          |

**54.06 METHOD OF MEASUREMENT AND BASIS OF PAYMENT.** Paint and painting will not be measured separately or paid for directly, but shall be considered incidental and necessary to the work for which it is specified and shall be included in the payment for those items.







## SECTION 57

### RIPRAP



**57.01 DESCRIPTION.** "Riprap" shall consist of a revetment of the type specified, composed of stone, fragmented rock or concrete or sacked concrete, placed as a protective covering, along the slopes of embankments, around culvert inlets or outlets, around foundations, bridge, berms, dykes or at such other places as may be directed in conformity with the plans and specifications.

**57.02 HAND LAID AND RANDOM RIPRAP. (1) Material.**

**(A) General.** The stone fragmented rock or concrete shall be hard, sound, durable, free of weak laminations and cleavages and of a quality that will not disintegrate on exposure to water or weathering. It shall not have a wear exceeding forty-five (45) percent at five-hundred (500) revolutions as determined by A.A.S.H.O. Method T-96 (Los Angeles Rattler Test).

**(B) Hand Laid Riprap.** Each stone or fragment shall be not less than three (3) inches thick nor contain less than one-half ( $\frac{1}{2}$ ) cubic foot in volume or weigh less than seventy-five (75) pounds. No stone or fragment shall be used that does not extend through the revetment.

**(C) Random Riprap.** (a) General Requirements. Stone shall be free from structural defects such as incipient fractures and seams and shall have given evidence of ability to withstand weathering after long exposure to the elements. Stone containing shale, unsound sandstone, or any other material which will readily disintegrate, shall not be used.

(b) Type A. At least eighty (80) percent by weight of the stone or fragments shall have a volume of not less than one (1) cubic foot or a weight of not less than one-hundred-fifty (150) pounds.

(c) Type B. Not less than forty (40) percent of the total volume shall be composed of stones having a volume of not less than four (4) cubic feet with a minimum dimension of twelve (12) inches and not more than twenty (20) percent of the total volume may be composed of stones having a volume of less than one (1) cubic foot with a minimum dimension of four (4) inches.

**(2) Construction methods. (A) Hand laid riprap.** A trench of the design and dimensions shown on the plans, and/or as directed by the engineer, shall be excavated along the toe of the slope to a stable foundation or carried to a point below scour, but in no case less than two (2) feet below the toe of the slope and a course of the largest stone placed therein. The slope to be protected shall not be steeper than the angle of repose of the material, unless otherwise directed. The stones shall be placed with their beds at right angles to the slope and so far as practicable the larger stones shall be used in the lower courses. They shall be laid in close contact so as to break joints and so placed that each stone will rest on the slope of the embankment and not wholly on the stone beneath it. The spaces between the larger stones shall be filled with spalls securely rammed into place. Ends of riprap walls

shall be keyed into the earth or embankment slopes a minimum of twenty-four (24) inches from the outer face of the riprap and for the full height of the riprap wall. The finished work shall present an even, tight and reasonably plane surface, varying not more than three (3) inches from the general contour of the revetment.

Where the thickness of the riprap is not shown on the plans it shall be at least twelve (12) inches measured perpendicular to the slope.

**(B) Random Riprap.** The stone, graded so that the smaller stone is uniformly distributed throughout the mass, shall be handled or dumped on the designated slopes to form the cross section shown on the plans or as directed by the engineer. The rock shall be manipulated by hand or machine methods sufficiently to secure a regular surface and mass stability. Where the thickness of the riprap is not shown on the plans it shall be at least eighteen (18) inches measured perpendicular to the slope. Unless otherwise directed, riprap shall extend from two (2) feet below the toe of the slope to mean high water elevation.

**57.03 GROUTED RIPRAP.** Except as hereby provided, "Grouted Riprap" shall conform to the specifications for "Hand Laid Riprap."

**(1) Material.** (a) Grout shall consist of one (1) part of Portland Cement and three (3) parts of sand, thoroughly mixed with water to produce a mortar of a thick cream consistency. Mortar shall be used within thirty (30) minutes after water is added and the mortar shall not be retempered.

(b) Mortar sand shall conform to the requirements of Paragraph (c) 1, "Fine Aggregates," Article 46.04, Subsection 46.00, "Concrete," with the exception of the Grading which shall be according to the following table:

Passing a No. 4 Sieve.....	100%
Passing a No. 8 Sieve.....	90-100%
Passing a No. 16 Sieve.....	60- 90%
Passing a No. 50 Sieve.....	15- 40%
Passing a No. 100 Sieve.....	0- 10%

**(2) Construction Methods.** The revetment shall not be less than nine (9) inches in thickness. Care shall be taken to keep earth and sand from filling the spaces between the stones.

After the stone has been placed, the voids shall be filled with spalls or small stones in such a manner that all stones are tightly wedged or keyed. The finished surface shall present an even, tight surface, with the plane not varying more than three (3) inches from the general contour.

Following completion of laying all stone in the revetment and immediately preceding the placing of any grout, the surface shall be wetted with water. The crevices and openings

shall be filled with mortar to a minimum depth of three (3) inches, followed immediately by sweeping the surface with a stiff broom.

Grouting will not be permitted in freezing weather. When grouting is done in hot dry weather the work shall be protected by keeping it moist with water or a wet earth blanket for three (3) days following its completion.

**57.04 SACKED CONCRETE RIPRAP. (1) Material.** The concrete, produced in an approved type mixer, shall consist of one (1) part of Portland cement and ten (10) parts of aggregate by volume. Pit run aggregate material complying with these specifications may be used. The amount of water added at the time of mixing shall be such as to result in a mixture with a three (3) to five (5) inch slump when tested in accordance with A.A.S.H.O. Method T-119. Sacks shall be sound, ten (10) ounce burlap sacks or equal, approximately eighteen (18) inches wide by thirty (30) inches long. If reclaimed, they shall not have contained any materials injurious to concrete. The aggregate shall consist of gravel and sand meeting the following grading requirements:

Passing a screen having 3-inch square openings.....	100%
Passing a screen having ¼-inch square openings.....	30-50%
Passing a 100-mesh sieve, not more than.....	5%

Aggregate shall be free of organic matter or other deleterious substances.

**(2) Construction Methods.** Trenching preparation for sacked concrete riprap shall conform to the requirements of Article 57.02, "Hand Laid Riprap."

The sacks shall be filled two-thirds (2/3) with concrete and securely tied with heavy cord. Immediately upon filling, the sacks shall be placed by hand methods and kneaded into conformance with the trench and backslope or the adjacent sacks already in position. They shall be of uniform thickness along any cross section that is perpendicular to the longitudinal axis of the sack.

The first course of sacks shall consist of a single row of "stretchers" laid in the trench with the tied ends out. The second course shall consist of a single row of "headers" laid with the tied ends toward the earth slope. All succeeding courses shall be laid as "stretchers" with the tied ends out. All sacks shall be laid in "broken joints." Joints shall be staggered to pattern and firmly kneaded into position to form a good bond. All dirt and debris shall be removed from the top of the sacks before the succeeding course is placed.

Not more than five (5) courses of sacks shall be placed in any tier until the initial set in the first course of any such tier has taken place. In placing, care in shaping the sacked concrete shall be exercised to obtain the minimum dimensions shown in the plans and to provide a minimum of voids. Sacked concrete shall be kept moist as erection progresses and for a period of twenty-four (24) hours following completion, by water sprinkling, moist earth covering or other satisfactory means.



**57.05 METHOD OF MEASUREMENT.** Hand-Laid, Random, and Sacked Concrete Riprap will be measured to the nearest one-tenth (0.1) cubic yard of the completed and accepted riprap in place. "Concrete Slab Riprap" will be covered by plan requirements and supplemental specifications for each case.

Grouted Riprap will be measured on the face of the revetment to the nearest one-tenth (0.1) square yard of the completed and accepted riprap in place.

**57.06 BASIS OF PAYMENT.** Riprap will be paid for at the contract unit bid price, which price and payment shall be full compensation for furnishing all materials, including mortar, concrete and sacks, handling, hauling, labor, tools, equipment, backfilling, and all incidentals necessary to complete the work, including trench excavation unless otherwise specified.

When shown on the plans and stipulated in the proposal, trench excavation will be measured and paid for in accordance with the requirements of Subsection 11.60, "Excavation for Culverts and Retaining Walls."

Item Number	Item Description	Unit
5710	Hand-Laid Riprap	Cubic-Yard
5720	Type "A" Random Riprap	Cubic Yard
5722	Type "B" Random Riprap	Cubic Yard
5730	Grouted Riprap	Square Yard
5740	Sacked Concrete Riprap	Cubic Yard
5750	Concrete Slab Riprap	Cubic Yard





## SECTION 58

### RUBBLE MASONRY



**58.01 DESCRIPTION.** "Rubble Masonry" shall consist of either "dry" or "cement" walls, as specified, composed of the stones or quarried rock, constructed in conformity with the plans and specifications and/or as directed by the engineer.

**58.02 MATERIAL.** Stone or rock shall be hard, sound, durable, free from rounded, worn or weathered surfaces, weak laminations or cleavages and clean of earth, clay or other foreign substances. It shall not have a wear exceeding forty (40) per cent at five-hundred (500) revolutions as determined by A.A.S.H.O. Method T-96.

No stone or rock shall be used which has a thickness of less than five (5) inches, or a width less than twelve (12) inches, or which is less than one-half ( $\frac{1}{2}$ ) cubic foot in volume.

Mortar for cement rubble masonry shall conform to the requirements for "Grouted Riprap," Section 57.

**58.03 CONSTRUCTION METHODS.** (a) General. All masonry shall be laid to lines and in courses roughly leveled up. The bottom or foundation courses shall be composed of large selected stones and all courses shall be laid with bearing beds parallel to the natural bed of the material. The vertical joints in each course shall break joints with those in adjoining courses at least six (6) inches. In no case shall a vertical joint be so located as to occur directly above or below a header. Stones shall be so placed that they have firm bearing and will be well bonded.

Headers shall be distributed uniformly throughout the wall, so as to form approximately one-fifth ( $\frac{1}{5}$ ) of the exposed faces, and shall extend through the face wall and into the backing at least twelve (12) inches. Where a wall is less than eighteen (18) inches thick, the headers shall extend entirely through from front to back face. Where the wall is more than eighteen (18) inches thick, the headers shall either extend entirely through or overlap at least six (6) inches.

(b) **Dry rubble masonry.** In all cases the base thickness of the wall shall be at least half the height, which shall not exceed eight (8) feet. The wall face shall be constructed with a batter of not less than one (1) inch to one (1) foot.

Dry rubble masonry shall be built up so as to leave no appreciable open spaces, and only sufficient spalls shall be used to wedge the stones into place. This class of masonry shall be finished with a top course or coping consisting of roughly shaped stones not less than six (6) inches thick, from one-and one-half ( $1\frac{1}{2}$ ) to four (4) feet long, and wide enough to cover the top of the wall, carefully laid in solid beds.

(c) **Cement rubble masonry.** All stones shall be thoroughly wet prior to laying and shall be fully bedded in mortar. Mortar which is not used within thirty (30) minutes after water has been added shall be wasted. Retempering of mortar will not be permitted. Mortar shall be produced in a mixer of approved type.

The interior of the walls shall be built up so that the stones of which it is composed will be bonded and so that no open spaces will be left. Horizontal joints in the face shall

not exceed one (1) inch in thickness and vertical joints shall not exceed two (2) inches in width. No spalls shall be used in the face of a wall, and the face stones shall be so well bedded that none will be needed. Walls shall be provided with weep holes wherever shown on the plans or as directed. If a stone is loosened after the mortar has set it shall be removed, the mortar cleaned off, and the stone relaid with fresh mortar.

Cement rubble masonry shall be finished with a concrete coping or with a top course consisting of roughly shaped stones. Copings, bridge seats, and backwalls, unless otherwise specified, shall be of class "A" concrete as specified by Subsection 46.00, which shall be not less than eight (8) inches thick and wide enough to cover the full width of the wall and shall be cast in place. If a stone coping is specified, the stone shall be not less than eight (8) inches thick, from one-and-one-half (1½) to four (4) feet long and wide enough to cover the top of the wall, set in full mortar beds as shown on the plans.

After the stone is all laid as specified the face joints shall be thoroughly cleaned of all mortar to a depth of one (1) inch. The joints shall then be wetted and pointed with Portland cement mortar mixed in the proportion of one (1) part of cement to one (1) part of sand.

No masonry shall be laid or pointing done in freezing weather nor when stone contains frost, unless otherwise directed. In hot or dry weather the masonry before and after pointing shall be satisfactorily protected from the sun and kept wet for a period of at least three (3) days before completion. Any work damaged by frost or because of improper protection from the sun shall be removed and replaced at the contractor's expense.

**58.04 METHOD OF MEASUREMENT.** Rubble masonry will be measured to the nearest one-tenth (0.1) cubic yards of the completed and accepted work, in accordance with plan dimensions, unless otherwise directed.

**58.05 BASIS OF PAYMENT.** Rubble masonry will be paid for at the contract unit bid price which price and payment shall be full compensation for furnishing all materials, including stone or rock, mortar, copings, all labor, tools, equipment, backfilling and all incidentals including trench excavation, unless otherwise specified, necessary to complete the work.

Trench excavation, when shown on the plans and stipulated in the proposal, will be measured and paid for in accordance with the requirements of Subsection 11.60, "Excavation for Culverts and Retaining Walls."

Item Number	Item Description	Unit
5810	Dry Rubble Masonry	Cubic Yard
5820	Cement Rubble Masonry	Cubic Yard







## SECTION 59

### HAND-LAID ROCK EMBANKMENT



**59.01 DESCRIPTION.** "Hand-Laid Rock Embankment" shall consist of strengthening embankments when slopes have been necessarily steepened, by the use of handlaid rock placed as shown on the plans, in conformity with the specifications and/or as directed by the engineer.

**59.02 MATERIAL.** The stone for this work shall be sound and durable, not less than one-half ( $\frac{1}{2}$ ) cubic foot in volume, and may be taken from the adjacent excavation.

**59.03 CONSTRUCTION METHODS.** An adequate footing shall be excavated in stable ground along the toe of the slope of the proposed fill. The selected stone material shall be placed by hand on this prepared footing and additional stone laid up to the width and dimensions directed. Care shall be taken to have the stones securely bedded and bonded. Spalls shall be used to fill voids. The hand-laid rock embankment thus constructed shall be backed by the usual embankment placed as prescribed under Subsection 11.80, "Embankment."

**59.04 METHOD OF MEASUREMENT.** Hand-laid rock embankment will be measured to the nearest cubic yard of completed and accepted work. The excavation for the footing prescribed shall not be measured.

When rock material for this item is obtained from roadway or other prescribed excavation, no deduction from the excavation yardage for the stone so used shall be made.

**59.05 BASIS OF PAYMENT.** Hand-laid rock embankment will be paid for at the contract unit bid price, which price and payment shall be full compensation for selecting and placing by hand the material, for all footing excavation, (unless specified otherwise), equipment, tools, labor and incidentals necessary to complete the work. If and when excavation for hand-laid rock embankment is a separate item, it shall be covered by the provisions of Subsection 11.60.

---

Item Number	Item Description	Unit
5910	Hand-Laid Rock Embankment	Cubic Yard
5911	Hand-Laid Rock Embankment	Lump Sum

---



## **SECTION 60**

### **PIPE CULVERTS**



**60.01 DESCRIPTION.** This specification describes the general requirements for all types, classes and designs of standard manufacture precast or prefabricated and structural plate culvert pipe, including the extension of existing culverts, except as may be modified or supplemented in any of the particular specifications for the respective pipe culverts specified. The exact types, classes, shapes, dimensions and locations for the culverts will be stipulated in the proposal, shown on the plans and/or designated by the engineer.

The locations and length of individual pipe culverts shown on the plans are approximate only and are subject to revision, as may be required during the course of the work.

**60.02 MATERIALS AND MANUFACTURE.** All culvert pipe used in the completed and accepted work shall conform to the requirements for materials and manufacture as set forth in the specifications for the particular type, class and design specified and shall have been tested according to the requirements and accepted for use, by the engineer, at the manufacturing source. Any pipe showing manufacturing and/or material defects which prevent proper installation or shows abuse or damage from improper handling in transit or on the job shall not be installed.

**60.03 CONSTRUCTION METHODS.** (a) Except as may be modified or supplemented by the proposal and/or plans for any of the respective types, classes or designs, all pipe shall be installed in accordance with the requirements of this specification.

(b) Culverts under the roadbed shall be so placed that the minimum distance from finished grade of the roadway to the top of the pipe shall be not less than one-half ( $\frac{1}{2}$ ) diameter of the pipe with a minimum of one (1) foot below subgrade shoulder elevation.

In the absence of specific requirements and/or plans for any particular installation of multiple lines of pipe, the culverts when fitted with aprons or flared end sections, shall be laid in such position that the ends of the aprons or flared end sections will form contact. Where installations with straight end sections are laid, the lines shall be separated by a distance at least equal to the inside diameter of the pipe, not to exceed a maximum of four (4) feet.

(c) **Foundation Preparation.** The foundation shall be prepared according to the lines and grades established by the engineer, with allowances being made for the required camber. The foundation shall be of required density and firm bearing ability throughout, and shall be carefully shaped to fit the lower twenty (20) percent of the outside circumference of the pipe. In the case of arch types the foundation shall conform to the pipe area between the exterior span points.

Where foundation preparation requires a trench it shall be excavated to width sufficient to permit thorough compaction of the backfill material around the pipe as hereinafter



specified. Where the foundation, at the established grade, is unstable the material in the unstable areas shall be removed for a width of at least one (1) diameter (or span) on each side of the pipe and the excavation backfilled with the type of material specified by the engineer.

When the trench is in solid rock, or other hard material, it shall be excavated to a depth of at least twelve (12) inches below the grade established for the bottom of the pipe. This additional excavation shall be backfilled with suitable material in such manner as to insure uniform bearing throughout. The foundation area shall be entirely free of protruding stones and/or other obstructional or undesirable matter.

The foundation area, including any backfill, shall be compacted with mechanical tampers and/or suitable rolling equipment, in accordance with the requirements, including "density," of Article 11.83, Construction Methods, Subsection 11.80, "Embankment," except that the layers of material shall not exceed a depth of four (4) inches of loose thickness.

Aggregate backfill, when specified, shall be placed in accordance with the provisions of Section 62 for the particular pipe to be installed and/or as directed by the engineer.

When the foundation area is composed principally of suitable granular type material for a sufficient depth the specified aggregate backfill may be omitted, when directed by the engineer.

No pipe shall be laid until the foundation has been approved by the engineer. Any pipe laid without prior approval of the foundation shall be removed and properly relaid at no additional cost to the State.

**60.04 INSTALLATION. 1. Precast Rigid Pipe.** (Reinforced concrete, concrete, tile, etc.) Unless otherwise directed, this type of pipe shall be laid on the foundation in standard section lengths, starting at the outlet end of the culvert, with the groove or bell ends up grade, with all bell ends suitably recessed into the foundation.

The tongue and/or spigot end, as the case may be, of each section shall be forced into the respective groove or bell end to abut the end of the preceding section, using a cable and winch method, when necessary, to force the sections to a positively tight fitting joint. Timber or other suitable cradles or skids shall be used to facilitate the installation in securing planned line and grade on heavy sections of large dimension pipe.

After all sections in the installation have been tightly jointed, and immediately preceding the use of any mortar, the joints shall be thoroughly wetted with water. Immediately following wetting of each joint, mortar of proper consistency, composed of one (1) part Portland cement and two (2) parts of sand meeting requirements of sand specified in Article 57.03 shall be forced into any voids that may exist in the entire exterior circumference of the joints and the joints wiped clean to present a tight, smooth, clean, neat appearance. Mortar shall be used within thirty (30) minutes after water is added and the mortar shall not be retempered.

Mortaring of the joint exteriors shall be accomplished in the same manner. The interior of the bell around the spigot shall be tightly filled with mortar flush with the end of the bell. The accessible portion of the external joint of the tongue and groove type shall be tightly filled with mortar flush with the surface of the pipe.

Standard commercial kinds of prepared mortar may be used, with prior approval of the laboratory.

In lieu of mortaring of joints, standard factory type gaskets or standard devices or methods of joint caulking, may be used, with prior approval of the engineer.

(a) **Siphon Pipe.** Joints on siphon pipe shall be so made as to be positively water-tight. Any standard type of caulking method or device, such as lock joint, copper strip or rubber gasket, may be used, with prior approval of the engineer. In the case of copper strip or lock joint, mortar of the specified kind shall be used in combination to form a watertight joint.

(b) **Sanitary Sewers.** Where the sewer installation is to carry sewage, the joints between sections of pipe shall be made as follows:

The bell shall be partially filled with plastic cement mortar (1:2 mix), extending completely around the pipe and being sufficient to fill the joint to about one-third (1/3) width. A gasket of hemp or oakum shall then be drawn up to extend completely around the spigot, with a lap at the top, and forced well back into the joint, pushing the cement mortar ahead of it so as to completely fill all space in the back portion of the joint with care being taken to maintain a truly concentric joint. The unfilled portion of the joint then shall be filled with plastic cement mortar (1:2 mix) the mortar being firmly pressed into the joint and being bevelled off to an angle of forty-five (45) degrees with the outside of the pipe. The joint on the inside of the pipe shall then be filled with mortar and wiped or trowelled to eliminate all excess mortar.

All angles, turns and branch connections shall be made with standard manufactured sections. All dead ends of sewers and branches shall be closed with approved stoppers securely cemented in place.

Trenches in which any type sewers are to be constructed shall be kept as nearly dry as practicable and there shall be no water in the trench at the time the pipe is placed or during the period that the joint filler material is setting.

**2. Prefabricated Flexible Pipe.** (Corrugated Metal, Siphons, Etc.,) The pipe shall be laid on the foundation with separate sections firmly butted together with outside laps of circumferential joints pointing upgrade and with the longitudinal joints on the sides. The sections shall be connected with specified types of coupling bands firmly bolted. The coupling bands shall be tapped with a mallet or other suitable tool as they are tightened.

Pipe shall be so handled in laying as to prevent bruising, scaling or breaking of the spelter coating. In no case shall pipe be dropped or dragged in unloading or on the ground.

Unless design and manufacture of the pipe has provided accordingly, all pipe forty-eight (48) inches in diameter and over, under fill cover twenty-five (25) feet or more in height, shall be elongated vertically approximately five (5) percent before any backfill is made. Field elongation shall be performed by strutting in accordance with the manufacturer's current specifications.

**(a) Siphon Pipe.** Field connections of siphon pipe will not be permitted within the area between the shoulders of the finished roadway. Field joints of siphon pipe connections shall be made with either of the two following described methods to form positively watertight joints:

1. A collar with a minimum thickness of six (6) inches, extending at least one (1) foot each side of the joint, composed of Class "D" concrete, cast around the joint. (See Subsection 46.00, "Portland Cement Concrete.")

2. A corrugated metal coupling band twelve (12) inches wide for all diameters of pipe. The coupling band shall be tightened around the joint by means of four (4) round mild steel galvanized rods, seven-sixteenths (7/16) inch or one-half ( $\frac{1}{2}$ ) inch diameter, formed to the circumference of the pipe, threaded for at least five (5) inches at both ends of the rods. The rods shall be of sufficient length for insertion through a two (2) hole tank lug and secured by means of galvanized hexagonal nuts.

There shall also be furnished, with each coupling band, sufficient asphalt compound of such consistency that it may be formed by hand in the field into asphalt "ropes" for filling the second corrugation on the end of each pipe section before the band is placed around the pipe, thus providing a watertight bond between the pipe and coupling band. Also to be furnished is a rubber gasket or other approved material, for insertion under the laps of the coupling band.

**(3) Structural Plate Types.** All pipe of this type shall be erected on a foundation prepared in the manner specified, shaped to conform with the particular installation being made. Except as herein modified or supplemented, field erection shall be performed in accordance with the specifications furnished by the manufacturer and/or as stipulated in the proposal and shown on the plans. Erection shall not be started or proceed until the engineer and contractor have these specifications and instructions at the work site.

All bolts used in the erection of any type shall be tightened to a torque of two-hundred (200) foot pounds with a tolerance of plus or minus twenty-five (25) pounds. During the course of installation, the engineer will make sufficient tests of the tightened bolts to insure strict compliance with this requirement.

**4. Pipe Underdrains.** All pipe installed for this purpose shall be laid in a trench excavated to the lines and grades shown on the plans and/or as established by the engineer. The bottom of the trench shall be shaped to accurately fit the pipe and shall be of sufficient dimension to permit placing of approved type aggregate backfill material. Unless otherwise provided, the pipe shall be laid in such manner that it is encased in a minimum of twelve (12) inches of aggregate backfill material, approved by the engineer.

Perforated pipe shall be laid with the perforations down, unless otherwise directed. The earth backfill material shall be placed adjacent to the aggregate material and compacted in the manner specified for foundation preparation under Paragraph (c), Article 60.03, of this specification.

**5. Rigid Type Underdrains.** All underdrain pipe of this type shall be laid in the same manner as flexible type underdrains and according to the specifications for installation of surface drain pipe, except that the joints shall be left open with the spigot or tongue end one-half ( $\frac{1}{2}$ ) inch from the preceding invert end. All joints shall be wrapped with a six (6) inch strip of ten (10) ounce burlap one-and-one-half ( $1\frac{1}{2}$ ) times around the joint, the lap providing double thickness on top of the joints.

**60.05 BACKFILLING. (a) (All Types.)** Except as may be otherwise particularly specified for certain types of installation, all backfill material shall be uniformly placed over the entire culvert foundation area around the pipe in layers of not more than six (6) inches loose thickness. The material adjacent to the pipe shall be free of sticks, stones, frozen lumps or clods and shall be hand-placed and tamped in the same manner and to the same density as specified for foundation preparation. Particular care shall be exercised in uniformly and firmly tamping the backfill material under the haunches of the pipe.

Backfill in the rest of the foundation and adjacent embankment area shall be placed and compacted in the manner specified in Article 11.86, Subsection 11.80, "Embankment," bringing the embankment up uniformly along the entire length of the culvert. Placing of embankment over the pipe, in the customary manner of grading operations shall not proceed until the pipe has been covered to a depth equal to one-half ( $\frac{1}{2}$ ) diameter of the pipe but in no case less than two (2) feet of backfill material compacted in accordance with the specified method.

If the pipe has been laid in a trench, the trench shall be backfilled and tamped and/or otherwise compacted to the same density requirements specified in Article 11.86.

Backfilling around rigid type pipes that have been grouted shall not be performed until twenty-four (24) hours after the grout has been placed.

Backfill and embankment shall be kept symmetrical on all sides of structures and their component members to avoid displacement and/or unbalanced stresses.



**(b) Imperfect Trench Method.** When reinforced concrete culverts are installed beneath an embankment, where the finished grade is more than ten (10) feet above the top of the pipe, backfill shall be performed according to the following described "imperfect trench" method.

Following installation of the pipe according to specified methods, the embankment shall be brought up, in the normal course of construction, in the prescribed manner to a height above the top of the pipe equal to that of the pipe diameter. The embankment material in the prism directly over the pipe shall be excavated to the level of the top of the pipe and the trench shall be backfilled with earth material, deposited in the loosest possible manner. Following backfilling of the trench, construction of the embankment shall continue in conformance with standard methods.

Excavation of the fill in the prism above the pipe will not be measured or paid for directly but shall be considered as a subsidiary obligation and necessary and incidental to installation of the culvert and included in the contract unit bid price for the pipe.

**(c) Rock Embankment.** In case the installation is to be under an embankment principally composed of blasted or fractured rock of varying dimension, the exposed surfaces of the pipe shall be encased with a minimum of two (2) feet of compacted earth backfill material and the rock embankment material then placed around the pipe for an area equal to one-half ( $\frac{1}{2}$ ) diameter, in accordance with the construction requirements set forth in Section 59, "Hand Laid Rock Embankment." Excavation of the prism over the pipe, in cases of this kind, will not be required. Placing of the earth backfill material and hand-laid rock embankment will not be measured or paid for separately, but will be considered incidental and necessary to the installation of the pipe and included in the contract unit bid price for the pipe.

**60.06 METHOD OF MEASUREMENT.** All pipe used in the completed and accepted work will be measured to net ends by the lineal foot.

Precast types of pipe will be measured to the nearest foot on the basis of the number of sections used in the installation and the nominal net length of each, including flared end sections.

Prefabricated and structural plate types of circular or elliptical pipe will be measured on the axis of and end to end of the installation including flared end sections. For installations with beveled ends, the length will be an average of the top and bottom lengths.

Prefabricated arch types with sloping ends will be measured from end to end of the installation along the centerline including flared ends.

Structural plate arch types with sloping and/or skewed ends will be measured on the bottom along the installation centerline.



Structural plate stockpasses shall be measured on the bottom along the installation centerline.

Measurement of siphon installations shall include required angles or elbows. Siphons shall be measured on the axis of the pipe.

Pipe installed in excess of the length ordered by the engineer will not be measured.

**60.07 BASIS OF PAYMENT.** Pipe culverts and stockpasses will be paid for at the contract unit bid price, which price and payment, unless otherwise specified, shall be full compensation for furnishing and installing the pipe, hauling, handling, preparation of the pipe foundation, placing and compacting earth backfill material, furnishing the timber for and strutting the pipe when specified, and for all materials, mortar, coupling bands, bolts, fitting, labor, tools, equipment and for all incidentals necessary to complete the pipe installation.

Upon completion of the contract and/or when directed, the strutting shall be removed by the contractor at his own expense. If, in the judgment of the engineer, the strutting shall remain in place for a period beyond the contract acceptance date, it will be removed by state forces.

Should it be determined in construction that the length of any culvert or installation of pipe shown on the plans is inadequate, then the contractor shall provide and place the additional length required at the contract unit bid prices for the appropriate type and dimension, including the furnishing and placing of additional coupling bands.

There are no item numbers assigned to this section.



## SECTION 61

### REMOVAL AND RELAY OF PIPE CULVERTS



**61.01 DESCRIPTION.** "Removal and Relay of Pipe Culverts" shall consist of the removal of any type, class and dimension of pipe culvert from beneath the existing roadbed and/or from other locations shown on the plans, or as directed. The work shall also include the cleaning, preserving and relaying of this pipe at locations, as directed or shown on the plans and/or storing of the pipe on the project, as may be directed.

**61.02 CONSTRUCTION METHODS.** Excavation necessary for the removal of pipe culverts may be made by any method that does not involve injury to the pipe. Any pipe which, in the course of removal or handling, becomes bent, torn, crushed or otherwise damaged beyond reuse shall be replaced by the contractor with an equal length of pipe of the same diameter, of quality and condition equivalent to the condition of the damaged pipe prior to its removal.

Backfill of the excavation occasioned by removal of any pipe culvert within the templet section of the new roadway shall be performed in accordance with the requirements of Article 11.86, Subsection 11.80, "Embankment."

Relaying of pipe shall be performed in accordance with the pertinent requirements of Section 60, "Pipe Culverts."

**61.03 METHOD OF MEASUREMENT.** When stipulated in the proposal and shown on the plans removal of pipe culverts will be measured by the lineal foot of the completed and accepted work, in accordance with the pertinent requirements of Section 60. When shown on the plans, but not stipulated in the proposal, removal of pipe culverts will be considered subsidiary to the "Culvert Excavation" required of their removal.

Relay of pipe culverts will be measured by the lineal foot of the completed and accepted work, in accordance with the pertinent requirements of Section 60.

The quantity is not guaranteed to be used or required and the engineer reserves the right to increase, decrease, or to omit all or any part of this item and no additional compensation will be allowed by reason thereof.

Excavation used in the removal of pipe culverts to be relayed and/or stored on the project will be measured in accordance with the requirements of Subsection 11.60, "Excavation for Culverts and Retaining Walls."

**61.04 BASIS OF PAYMENT.** Relay of pipe culverts will be paid for at the contract unit bid price, which price and payment shall be full compensation for removal, cleaning, preserving, cutting, handling, hauling, laying and/or storing any of the various types, sizes, classes and dimensions of pipe removed, or pipe furnished in lieu of that removed; for the furnishing of any coupling bands, mortar and for all labor, tools, equipment and incidentals necessary to complete the work.

Excavation required in the removal of pipe culverts to be relayed and/or in the relaying of the pipe will be paid for at the contract unit bid price for "Culvert Excavation," in accordance with the requirements of Subsection 11.60.

The excavation work necessary for the removal of old culverts of the various types, irrespective of size, shall be measured and paid for as culvert excavation in accordance with the provisions of that subsection. All other work involved in removing the old culverts, including the removal of headwalls, shall not be paid for directly but shall be considered as subsidiary work pertaining to the roadway and drainage excavation items.

Item Number	Item Description	Unit
6110	Removal of Pipe Culverts	Lineal Foot
6111	Removal of Pipe Culverts	Lump Sum
6120	Relay Pipe Culverts	Lineal Foot
6121	Relay Pipe Culverts	Lump Sum
6130	Removal and Relay of Pipe Culverts	Lineal Foot
6131	Removal and Relay of Pipe Culverts	Lump Sum







## **SECTION 62**

### **AGGREGATE BACKFILL FOR CULVERTS**



**62.01 DESCRIPTION.** "Aggregate Backfill" shall consist of a course or courses of granular material, placed for culvert foundations and backfill in accordance with the requirements of Section 60, "Pipe Culverts" and the plans and/or specifications and/or as directed.

**62.02 MATERIAL.** "Aggregate Backfill" shall meet the requirements of grading 1 as set forth in the Table of Gradations, Article 23.02, Section 23, "Selected Borrow Base Course," except that it shall be uniformly graded between the following limits:

Passing a screen with 3-inch square openings.....	100%
Passing a 4-mesh sieve.....	25 to 50%
Passing a 200-mesh sieve, not more than.....	15%

**62.03 METHOD OF CONSTRUCTION.** "Aggregate Backfill" material shall be placed in conformance with the requirements of Section 60, "Pipe Culverts."

**62.04 METHOD OF MEASUREMENT.** "Aggregate Backfill" shall be measured by the cubic yard as used in the completed and accepted work, compacted and complete in place.

**62.05 BASIS OF PAYMENT.** "Aggregate Backfill" shall be paid for at the contract unit bid price, which price and payment shall be full compensation for furnishing, unless otherwise specified, loading, hauling, spreading, watering and compacting it, and for all other materials, tools, labor, equipment, and incidentals necessary to complete the work.

Item Number	Item Description	Unit
6210	Aggregate Backfill	Cubic Yard
6220	Sand Backfill	Cubic Yard



## SECTION 63

### CORRUGATED METAL PIPE CIRCULAR AND ELLIPTICAL



**63.01 DESCRIPTION.** "Corrugated Metal Pipe" conforming to these specifications and the requirements of Section 60, "Pipe Culverts," shall be furnished and installed as specified by the plans and/or specifications or as directed.

**63.02 MATERIALS AND MANUFACTURE.** Corrugated metal pipe shall conform to the current requirements of A.A.S.H.O. Designation M-36, except as those requirements may be supplemented and/or modified herein or by special provisions.

"Perforated Pipe Culvert" shall conform to A.A.S.H.O. Designation M-36 as to material and to A.A.S.H.O. Designation M-136 as to fabrication. "Elliptical Pipe Culvert" shall be fabricated from round corrugated metal pipe conforming to A.A.S.H.O. Designation M-36. Pipes designated to be furnished in elliptical form shall be formed and fabricated at the plant or factory 5% out of round to form an elliptical section. The vertical axis—the longer axis of the elliptical section—shall be clearly marked before shipping.

The seams and joints of corrugated metal siphon pipe shall be close riveted and soldered watertight. This type of pipe shall, otherwise, conform to the requirements cited above.

**63.03 CONSTRUCTION METHODS.** Construction methods shall conform to the requirements of Article 60.03, Section 60.

**63.04 METHOD OF MEASUREMENT.** Methods of measurement shall be as provided in Article 60.06, Section 60.

**63.05 BASIS OF PAYMENT.** Payment shall be made in accordance with the provisions of Article 60.07, Section 60.

Corrugated metal pipe shall be designated by item numbers listed below.

Note: The item numbers shown below concern standard gages only, as manufactured.

Thus—a 15" pipe, 16 gage, will bear Item Number 6315.

—a 24" pipe, 14 gage, will bear Item Number 6324.

—a 60" pipe, 10 gage, will bear Item Number 6360.

If it is necessary to specify and use a heavier gage of metal, then the item number, when used in bid tabulations and project agreements, will bear a letter suffix. Those letter suffixes will be as follows:

A—14 gage

C—10 gage

B—12 gage

D— 8 gage

Thus, when a gage varying from standard is specified the item numbers will be as follows:

—a 15" pipe, 14 gage, will bear Item Number 6315 A.

—a 24" pipe, 10 gage, will bear Item Number 6324 C.

—a 60" pipe, 8 gage, will bear Item Number 6360 D.

If and when a size, type, use or treatment is specified that is not itemized below a number will be assigned.

Item No.	Dia.	Gage	Shape	Use	Treatment	Unit
6306	6	16	Round	Syphon	Perforated	Lineal Foot
07	6	16	Round			Lineal Foot
01	6	16	Round			Lineal Foot
6308	8	16	Round	Syphon	Perforated	Lineal Foot
09	8	16	Round			Lineal Foot
02	8	16	Round			Lineal Foot
03	8	16	Elliptical	Syphon	Perforated	Lineal Foot
6310	10	16	Round			Lineal Foot
11	10	16	Round			Lineal Foot
04	10	16	Round	Syphon	Perforated	Lineal Foot
05	10	16	Elliptical			Lineal Foot
6312	12	16	Round			Lineal Foot
13	12	16	Round	Syphon	Perforated	Lineal Foot
00	12	16	Round			Lineal Foot
14	12	16	Elliptical			Lineal Foot
6315	15	16	Round	Syphon		Lineal Foot
16	15	16	Round			Lineal Foot



Item No.	Dia.	Gage	Shape	Use	Treatment	Unit
17	15	16	Round		Perforated	Lineal Foot
20	15	16	Elliptical			Lineal Foot
6318	18	16	Round			Lineal Foot
19	18	16	Round	Syphon		Lineal Foot
23	18	16	Round		Perforated	Lineal Foot
26	18	16	Elliptical			Lineal Foot
6321	21	16	Round			Lineal Foot
22	21	16	Round	Syphon		Lineal Foot
28	21	16	Round		Perforated	Lineal Foot
29	21	16	Elliptical			Lineal Foot
6324	24	14	Round			Lineal Foot
25	24	14	Round	Syphon		Lineal Foot
33	24	14	Round		Perforated	Lineal Foot
34	24	14	Elliptical			Lineal Foot
6330	30	14	Round			Lineal Foot
31	30	14	Round	Syphon		Lineal Foot
38	30	14	Elliptical			Lineal Foot
6336	36	12	Round			Lineal Foot
37	36	12	Round	Syphon		Lineal Foot
40	36	12	Elliptical			Lineal Foot

Item No.	Dia.	Gage	Shape	Use	Treatment	Unit
6342	42	12	Round	Syphon		Lineal Foot
43	42	12	Round			Lineal Foot
44	42	12	Elliptical			Lineal Foot
6348	48	12	Round	Syphon		Lineal Foot
49	48	12	Round			Lineal Foot
46	48	12	Elliptical			Lineal Foot
6354	54	12	Round	Syphon		Lineal Foot
55	54	12	Round			Lineal Foot
50	54	12	Elliptical			Lineal Foot
6360	60	10	Round	Syphon		Lineal Foot
61	60	10	Round			Lineal Foot
52	60	10	Elliptical			Lineal Foot
6366	66	10	Round	Syphon		Lineal Foot
67	66	10	Round			Lineal Foot
6372	72	10	Round			Lineal Foot
73	72	10	Round	Syphon		Lineal Foot
6378	78	8	Round			Lineal Foot
79	78	8	Round			Lineal Foot
6384	84	8	Round	Syphon		Lineal Foot
85	84	8	Round			Lineal Foot





SECTION 64

CORRUGATED METAL PIPE

PIPE—ARCHES



**64.01 DESCRIPTION.** "Corrugated Metal Pipe-Arches," conforming to these specifications and the requirements of Section 60, "Pipe Culverts," shall be furnished and installed as specified by the plans and/or specifications or as directed.

**64.02 MATERIALS AND MANUFACTURE.** Corrugated metal pipe-arches, instead of being circular in form, shall be of a multi-centered form approximately in ellipse with arch shaped top and slightly outward curved integral bottom, having a vertical diameter or rise which is approximately sixty (60) percent of the horizontal diameter or span. Materials shall conform to the provisions of Article 63.02. Reference shall be made to plans and/or standard drawings concerning dimensional data, gage of metal, and other necessary information. Standard manufacturing practice concerning sheet sizes, lap, width of bands and weights per foot shall be followed unless specified otherwise.

The minimum radius of any part of the pipe arch section shall be four (4) inches.

The lapped longitudinal seams shall be factory riveted and shall be staggered so as to alternate on each side of the center of the top of the arch by approximately fifteen (15) percent of the periphery.

The radii to which the sheets are formed in fabrication shall be sufficiently great to prevent racking of the spelter coating.

**64.03 CONSTRUCTION METHODS.** Construction methods shall conform, in general, to the requirements of Article 60.03, Section 60. Strutting of pipe-arches will not be required, unless specified otherwise. Field joints shall be made from band couplers shaped to fit the pipe-arches.

**64.04 METHODS OF MEASUREMENT.** Methods of measurement shall be as provided in Article 60.06, Section 60.

**64.05 BASIS OF PAYMENT.** Payment shall be made in accordance with the provisions of Article 60.07, Section 60.

Corrugated metal pipe-arches shall be designated by item numbers listed on page 389.



Item Number	Dimensions	Gage	Item Description	Unit
6415	18x11	16	Corrugated Metal Pipe-Arch	Lin. Foot
6416	18x11	14	Corrugated Metal Pipe-Arch	Lin. Foot
6417	18x11	12	Corrugated Metal Pipe-Arch	Lin. Foot
6418	22x13	16	Corrugated Metal Pipe-Arch	Lin. Foot
6419	22x13	14	Corrugated Metal Pipe-Arch	Lin. Foot
6420	22x13	12	Corrugated Metal Pipe-Arch	Lin. Foot
6421	25x16	16	Corrugated Metal Pipe-Arch	Lin. Foot
6422	25x16	14	Corrugated Metal Pipe-Arch	Lin. Foot
6423	25x16	12	Corrugated Metal Pipe-Arch	Lin. Foot
6424	29x18	14	Corrugated Metal Pipe-Arch	Lin. Foot
6425	29x18	12	Corrugated Metal Pipe-Arch	Lin. Foot
6426	29x18	10	Corrugated Metal Pipe-Arch	Lin. Foot
6430	36x22	14	Corrugated Metal Pipe-Arch	Lin. Foot
6431	36x22	12	Corrugated Metal Pipe-Arch	Lin. Foot
6432	36x22	10	Corrugated Metal Pipe-Arch	Lin. Foot
6436	43x27	12	Corrugated Metal Pipe-Arch	Lin. Foot
6437	43x27	10	Corrugated Metal Pipe-Arch	Lin. Foot
6438	43x27	8	Corrugated Metal Pipe-Arch	Lin. Foot
6442	50x31	12	Corrugated Metal Pipe-Arch	Lin. Foot
6443	50x31	10	Corrugated Metal Pipe-Arch	Lin. Foot
6444	50x31	8	Corrugated Metal Pipe-Arch	Lin. Foot
6448	58x36	12	Corrugated Metal Pipe-Arch	Lin. Foot
6449	58x36	10	Corrugated Metal Pipe-Arch	Lin. Foot
6450	58x36	8	Corrugated Metal Pipe-Arch	Lin. Foot
6454	65x40	12	Corrugated Metal Pipe-Arch	Lin. Foot
6455	65x40	10	Corrugated Metal Pipe-Arch	Lin. Foot
6456	65x40	8	Corrugated Metal Pipe-Arch	Lin. Foot
6460	72x44	10	Corrugated Metal Pipe-Arch	Lin. Foot
6461	72x44	8	Corrugated Metal Pipe-Arch	Lin. Foot





**SECTION 65**

**STRUCTURAL PLATE ELLIPTICAL  
PIPE CULVERTS**



**65.01 DESCRIPTION.** "Elliptical Structural Plate Pipe Culverts" shall consist of furnishing and installations of such pipes, in conformity with the plans and specifications and the requirements of Section 60, "Pipe Culverts," except as may be herein provided or as may be directed by the engineer.

**65.02 MATERIAL AND MANUFACTURE. (1) General.** Elliptical Structural Plate Pipe Culverts, structural plate pipe-arch culverts and structural plate pipe stockpasses shall consist of curved sections of galvanized corrugated metal plate bolted together to form required shapes. The sizes and shapes of the plates shall be such that the finished structures will have the dimensions designated herein or on the plans. When ends are beveled, the angle of skew shall not exceed fifteen (15) degrees. Materials for elliptical pipe culverts, pipe-arch culverts, and stockpasses shall comply with the pertinent requirements of Division II, Section 23 and Division IV, Section 19, of A.A.S.H.O., "Standard Specifications for Highway Bridges," current edition.

Where structural plate pipe culverts, structural plate pipe-arch culverts or structural plate pipe stockpasses are already in place and called for on the plans to be lengthened, the new pipe extensions shall conform as nearly as practicable to the sectional shape of the existing pipe. Where the existing pipe has beveled ends, the beveled ends shall be removed, the new sections of culvert installed, and the beveled ends added thereto.

**(2) Elliptical Structural Plate Pipe Culverts.** Elliptical culverts shall be factory-formed with the vertical diameter elongated five (5) percent from a true circle and the horizontal diameter decreased a corresponding amount to retain equal periphery. Installation shall be with the major axis vertical. If strutting is required, no vertical distortion will be necessary. Unless otherwise called for on the plans, end plates shall be beveled on a 1½:1 slope above the flow line.

**65.03 HANDLING AND INSPECTION.** The field inspection shall be made by the engineer who shall be furnished by the seller with an itemized statement of the sizes and lengths of the plates in each shipment. This inspection shall include an examination of the culvert materials for deficiencies in the lengths of sheets used and any evidence of poor workmanship. The inspection may include taking of samples for chemical analysis and determination of weight of spelter coating. The plates making up the shipment shall fully meet the requirements of these specifications, and if twenty-five (25) percent of the plates in any shipment fails to meet these requirements, the entire shipment may be rejected.

Plates shall be transported, unloaded and handled in such a manner that there will be no damage to the plates. Damage resulting from improper methods of transportation or handling shall be sufficient cause for rejection of the pipe.

**65.04 CONSTRUCTION METHODS.** Construction methods shall conform to the requirements of Article 60.03, Section 60.

**65.05 METHOD OF MEASUREMENT.** Methods of measurement shall be as provided in Article 60.06, Section 60.

**65.06 BASIS OF PAYMENT.** Payment shall be made in accordance with the provisions of Article 60.07, Section 60.

**NOTE:** The Item Numbers shown below concerning the gage of metal listed opposite each number. Thus—

- a 60" pipe, 12 gauge, will bear Item Number 6560
- a 120" pipe, 10 gage, will bear Item Number 6520
- a 180" pipe, 10 gage, will bear Item Number 6580

If it is necessary to specify and use a heavier gage of metal, then the Item Number, when used in Bid Tabulations and Project Agreements, will bear a letter suffix. These letter suffixes will be as follows:

A—10 gage	C—7 gage	E—3 gage
B—8 gage	D—5 gage	F—1 gage

Thus, when a gage varying from those listed below, opposite each size, is specified the Item Numbers will be as follows:

- a 60" pipe, 10 gage, will bear Item Number 6560 A
- a 120" pipe, 5 gage, will bear Item Number 6520 D
- a 180" pipe, 3 gage, will bear Item Number 6580 E



Item No.	Dia.	Gage	Item Description		Unit
6560	60	12	Elliptical	Structural Plate Pipe Culvert	Lineal Foot
6566	66	12	Elliptical	Structural Plate Pipe Culvert	Lineal Foot
6572	72	12	Elliptical	Structural Plate Pipe Culvert	Lineal Foot
6578	78	12	Elliptical	Structural Plate Pipe Culvert	Lineal Foot
6584	84	12	Elliptical	Structural Plate Pipe Culvert	Lineal Foot
6590	90	12	Elliptical	Structural Plate Pipe Culvert	Lineal Foot
6596	96	12	Elliptical	Structural Plate Pipe Culvert	Lineal Foot
6502	102	12	Elliptical	Structural Plate Pipe Culvert	Lineal Foot
6508	108	12	Elliptical	Structural Plate Pipe Culvert	Lineal Foot
6514	114	10	Elliptical	Structural Plate Pipe Culvert	Lineal Foot
6520	120	10	Elliptical	Structural Plate Pipe Culvert	Lineal Foot
6526	126	10	Elliptical	Structural Plate Pipe Culvert	Lineal Foot
6532	132	10	Elliptical	Structural Plate Pipe Culvert	Lineal Foot
6538	138	10	Elliptical	Structural Plate Pipe Culvert	Lineal Foot
6544	144	10	Elliptical	Structural Plate Pipe Culvert	Lineal Foot
6550	150	10	Elliptical	Structural Plate Pipe Culvert	Lineal Foot
6556	156	10	Elliptical	Structural Plate Pipe Culvert	Lineal Foot
6562	162	10	Elliptical	Structural Plate Pipe Culvert	Lineal Foot
6568	168	10	Elliptical	Structural Plate Pipe Culvert	Lineal Foot
6574	174	10	Elliptical	Structural Plate Pipe Culvert	Lineal Foot
6580	180	10	Elliptical	Structural Plate Pipe Culvert	Lineal Foot



## SECTION 66

# STRUCTURAL PLATE ARCH CULVERTS AND STOCKPASSES



**66.01 DESCRIPTION.** "Structural Plate Pipe-Arch Culverts" and "Structural Plate Stockpasses" shall consist of the furnishing and installation of such pipe-arches and stockpasses in conformity with the plans and with these specifications and the requirements of Section 60, "Pipe Culverts," except as may be herein supplemented or modified.

**66.02 MATERIAL AND MANUFACTURE.** (1) **General.** The provisions of this paragraph are the same as those of Paragraph (1), Article 65.02, Section 65, "Elliptical Structural Plate Pipe Culvert."

(2) **Structural Plate Pipe-Arch Culverts.** Unless otherwise called for on the plans, end plates shall be beveled on a  $1\frac{1}{2}:1$  slope above the largest horizontal dimension. A tolerance of 4 percent will be allowed on span and rise of pipe-arches, providing the cross-sectional area is not substantially affected.

(3) **Structural Plate Stockpasses.** Stockpasses shall be formed by plates forming a cross-section composed of five circular arcs and a flat-bottom tangent at their junctions and symmetrical above the vertical axis. A tolerance of 4 percent will be allowed for span and rise of stockpasses.

Periphery shall be formed by not less than six plates nor more than eight plates. Span and rise of stockpasses shall be either Design "A", 6'6" by 5'10" or Design "B", 7'7" by 5'10" as indicated on the plans or standard drawing.

Unless otherwise called for on the plans, stockpasses shall have the ends step-beveled. Beveling shall commence at the bottom of the top plate and extend downward on a  $1\frac{1}{2}:1$  slope to the top of the corner plates.

**Design "A", 6'6" by 5'10" Stockpass.** The top of the stockpass shall be an arc having a radius of not less than 26 inches or more than 30 inches and shall not be less than  $100^\circ$  or more than  $130^\circ$ . The sides shall be arcs having a radius of not less than 60 inches or more than 72 inches. Corners shall be arcs having a radius of not less than 17 inches or more than 20 inches. The bottom shall be a flat segment not less than 29 inches or more than 34 inches in width.

**Design "B", 7'7" by 5'10" Stockpass.** The top of the stockpass shall be an arc having a radius of not less than 24 inches or more than 30 inches and shall not be less than  $110^\circ$  or more than  $145^\circ$ . The sides shall be arcs having a radius of not less than 85 inches or more than 112 inches. Corners shall be arcs having a radius of not less than 17 inches or more than 20 inches. The bottom shall be a flat segment not less than 29 inches or more than 34 inches in width.

**66.03 HANDLING AND INSPECTION.** The provisions of this paragraph are the same as those of paragraph (1), Article 65.02, Section 65, "Elliptical Structural Plate Pipe Culverts."

**66.04 CONSTRUCTION METHODS.** Construction methods shall conform to the requirements of Article 60.03, Section 60.

**66.05 METHOD OF MEASUREMENT.** Methods of measurement shall be as provided in Article 60.06, Section 60.

**66.06 BASIS OF PAYMENT.** Payment shall be made in accordance with the provisions of Article 60.07, Section 60.

**NOTE:** The Item Numbers shown below concerning the gage of metal listed opposite each number. Thus:

- a 6'1" x 4'7" culvert, 12 gage, will bear Item Number 6601.
- a 10'11" x 7'1" culvert, 10 gage, will bear Item Number 6616.
- a 16'7" x 10'1" culvert, 5 gage, will bear Item Number 6634.

If it is necessary to specify and use a heavier gage of metal then the Item Number, when used in bid tabulations and project agreements, will bear a letter suffix. Those letter suffixes will be as follows:

A—10 gage	C—7 gage	E—3 gage
B— 8 gage	D—5 gage	F—1 gage

Thus, when a gage varying from those listed below, opposite each size, is specified the Item Numbers will be as follows:

- a 6'1" x 4'7" culvert, 10 gage, will bear Item Number 6601 A.
- a 10'11" x 7'1" culvert, 7 gage, will bear Item Number 6616 C.
- a 16'7" x 10'1" culvert, 1 gage, will bear Item Number 6634 F.

Item No.	Span	Rise	Gage	Item Description	Unit
6601	6' 1"	x 4' 7"	12	Structural Plate Pipe Arch Culvert	Lineal Foot
6602	6' 4"	x 4' 9"	12	Structural Plate Pipe Arch Culvert	Lineal Foot
6603	6' 9"	x 4' 11"	12	Structural Plate Pipe Arch Culvert	Lineal Foot
6604	7' 0"	x 5' 1"	12	Structural Plate Pipe Arch Culvert	Lineal Foot
6605	7' 3"	x 5' 3"	12	Structural Plate Pipe Arch Culvert	Lineal Foot
6606	7' 8"	x 5' 5"	12	Structural Plate Pipe Arch Culvert	Lineal Foot
6607	7' 11"	x 5' 7"	12	Structural Plate Pipe Arch Culvert	Lineal Foot
6608	8' 2"	x 5' 9"	10	Structural Plate Pipe Arch Culvert	Lineal Foot
6609	8' 7"	x 5' 11"	10	Structural Plate Pipe Arch Culvert	Lineal Foot
6610	8' 10"	x 6' 1"	10	Structural Plate Pipe Arch Culvert	Lineal Foot
6611	9' 4"	x 6' 3"	10	Structural Plate Pipe Arch Culvert	Lineal Foot
6612	9' 6"	x 6' 5"	10	Structural Plate Pipe Arch Culvert	Lineal Foot
6613	9' 8"	x 6' 7"	10	Structural Plate Pipe Arch Culvert	Lineal Foot
6614	10' 3"	x 6' 9"	8	Structural Plate Pipe Arch Culvert	Lineal Foot
6615	10' 8"	x 6' 11"	8	Structural Plate Pipe Arch Culvert	Lineal Foot
6616	10' 11"	x 7' 1"	8	Structural Plate Pipe Arch Culvert	Lineal Foot
6617	11' 5"	x 7' 3"	8	Structural Plate Pipe Arch Culvert	Lineal Foot
6618	11' 7"	x 7' 5"	8	Structural Plate Pipe Arch Culvert	Lineal Foot



Item No.	Span	Rise	Gage	Item Description		Unit
6619	11' 10" x 7' 7"		8	Structural Plate	Pipe Arch Culvert	Lineal Foot
6620	12' 4" x 7' 9"		8	Structural Plate	Pipe Arch Culvert	Lineal Foot
6621	12' 6" x 7' 11"		8	Structural Plate	Pipe Arch Culvert	Lineal Foot
6622	12' 8" x 8' 1"		8	Structural Plate	Pipe Arch Culvert	Lineal Foot
6623	12' 10" x 8' 4"		8	Structural Plate	Pipe Arch Culvert	Lineal Foot
6624	13' 5" x 8' 5"		7	Structural Plate	Pipe Arch Culvert	Lineal Foot
6625	13' 11" x 8' 7"		7	Structural Plate	Pipe Arch Culvert	Lineal Foot
6626	14' 1" x 8' 9"		7	Structural Plate	Pipe Arch Culvert	Lineal Foot
6627	14' 3" x 8' 11"		7	Structural Plate	Pipe Arch Culvert	Lineal Foot
6628	14' 10" x 9' 1"		7	Structural Plate	Pipe Arch Culvert	Lineal Foot
6629	15' 4" x 9' 3"		7	Structural Plate	Pipe Arch Culvert	Lineal Foot
6630	15' 6" x 9' 5"		7	Structural Plate	Pipe Arch Culvert	Lineal Foot
6631	15' 8" x 9' 7"		7	Structural Plate	Pipe Arch Culvert	Lineal Foot
6632	15' 10" x 9' 10"		7	Structural Plate	Pipe Arch Culvert	Lineal Foot
6633	16' 5" x 9' 11"		5	Structural Plate	Pipe Arch Culvert	Lineal Foot
6634	16' 7" x 10' 1"		5	Structural Plate	Pipe Arch Culvert	Lineal Foot
	Rise Span					
6690	6' 6" x 5' 10"			Structural Plate	Stockpass—Design "A"	Lineal Foot
6691	7' 7" x 5' 10"			Structural Plate	Stockpass—Design "B"	Lineal Foot





## SECTION 68

### REINFORCED CONCRETE PIPE



**68.01 DESCRIPTION.** "Reinforced Concrete Pipe" conforming to these specifications, the plans and the requirements of Section 60, "Pipe Culverts," shall be furnished and installed as specified or as may be directed by the engineer.

**68.02 MATERIALS AND MANUFACTURE.** (1) Reinforced Concrete Pipe shall conform to the current requirements of A.A.S.H.O. Designation M-41, except as those requirements are herein supplemented and/or modified.

(2) Reinforced Concrete Pipe furnished under these specifications shall be produced by a manufacturing plant for which the method of manufacture and quality of product have been approved by the engineer prior to the date of award of contract.

(3) The equipment and methods for controlling the proportions for the concrete, forming, and placing the reinforcement, the consolidation of the concrete in the molds, the protection and curing of the pipe, the molds, headers and pallets, shall be inspected and approved by the engineer prior to beginning fabrication.

(4) The use of elliptical reinforcement in circular pipe or round reinforcement in elliptical or arch pipe will not be permitted.

(5) "Extra Strength" pipe shall be used in all cases where height of pipe cover exceeds twenty (20) feet. In case the class of pipe is not stipulated in the proposal and/or shown on the plans, it shall be understood that the pipe to be used shall be "Standard Reinforced Concrete Pipe." When stipulated in the proposal and/or shown on the plans, flared end terminal sections shall be used. These sections may, at the option of the contractor, be precast standard sections or they may be cast in place in conformity with the design shown on the plans or current standard drawings. Attention is directed to Section 7, Article 07.03, of the General Provisions.

**68.03 CONSTRUCTION METHODS.** Construction methods shall conform to the requirements of Article 60.03, Section 60.

**68.04 METHOD OF MEASUREMENT.** Methods of measurement shall be as provided in Article 60.06, Section 60.

**68.05 BASIS OF PAYMENT.** Payment shall be made in accordance with the provisions of Article 60.07, Section 60.

Item No.	Dia. (Inch)	Item Description		Unit
6812	12	Reinforced Concrete Pipe	Culvert	Lin. Ft.
6814	12	Reinforced Concrete Pipe	Culvert—Syphon	Lin. Ft.
6815	15	Reinforced Concrete Pipe	Culvert	Lin. Ft.
6817	15	Reinforced Concrete Pipe	Culvert—Syphon	Lin. Ft.
6818	18	Reinforced Concrete Pipe	Culvert	Lin. Ft.
6819	18	Reinforced Concrete Pipe	Culvert—Extra Strength	Lin. Ft.
6820	18	Reinforced Concrete Pipe	Culvert—Syphon	Lin. Ft.
6821	21	Reinforced Concrete Pipe	Culvert	Lin. Ft.
6822	21	Reinforced Concrete Pipe	Culvert—Extra Strength	Lin. Ft.
6823	21	Reinforced Concrete Pipe	Culvert—Syphon	Lin. Ft.
6824	24	Reinforced Concrete Pipe	Culvert	Lin. Ft.
6825	24	Reinforced Concrete Pipe	Culvert—Extra Strength	Lin. Ft.
6826	24	Reinforced Concrete Pipe	Culvert—Syphon	Lin. Ft.
6827	27	Reinforced Concrete Pipe	Culvert	Lin. Ft.
6828	27	Reinforced Concrete Pipe	Culvert—Extra Strength	Lin. Ft.
6829	27	Reinforced Concrete Pipe	Culvert—Syphon	Lin. Ft.



Item No.	Dia. (Inch)	Item Description	Unit
6830	30	Reinforced Concrete Pipe Culvert	Lin. Ft.
6831	30	Reinforced Concrete Pipe Culvert—Extra Strength	Lin. Ft.
6832	30	Reinforced Concrete Pipe Culvert—Syphon	Lin. Ft.
6833	33	Reinforced Concrete Pipe Culvert	Lin. Ft.
6834	33	Reinforced Concrete Pipe Culvert—Extra Strength	Lin. Ft.
6835	33	Reinforced Concrete Pipe Culvert—Syphon	Lin. Ft.
6836	36	Reinforced Concrete Pipe Culvert	Lin. Ft.
6837	36	Reinforced Concrete Pipe Culvert—Extra Strength	Lin. Ft.
6838	36	Reinforced Concrete Pipe Culvert—Syphon	Lin. Ft.
6842	42	Reinforced Concrete Pipe Culvert	Lin. Ft.
6843	42	Reinforced Concrete Pipe Culvert—Extra Strength	Lin. Ft.
6844	42	Reinforced Concrete Pipe Culvert—Syphon	Lin. Ft.
6848	48	Reinforced Concrete Pipe Culvert	Lin. Ft.
6849	48	Reinforced Concrete Pipe Culvert—Extra Strength	Lin. Ft.
6850	48	Reinforced Concrete Pipe Culvert—Syphon	Lin. Ft.
6854	54	Reinforced Concrete Pipe Culvert	Lin. Ft.

Item No.	Dia. (Inch)	Item Description		Unit
6855	54	Reinforced Concrete Pipe	Culvert—Extra Strength	Lin. Ft.
6860	60	Reinforced Concrete Pipe	Culvert	Lin. Ft.
6861	60	Reinforced Concrete Pipe	Culvert—Extra Strength	Lin. Ft.
6866	66	Reinforced Concrete Pipe	Culvert	Lin. Ft.
6867	66	Reinforced Concrete Pipe	Culvert—Extra Strength	Lin. Ft.
6872	72	Reinforced Concrete Pipe	Culvert	Lin. Ft.
6873	72	Reinforced Concrete Pipe	Culvert—Extra Strength	Lin. Ft.
6878	78	Reinforced Concrete Pipe	Culvert	Lin. Ft.
6879	78	Reinforced Concrete Pipe	Culvert—Extra Strength	Lin. Ft.
6884	84	Reinforced Concrete Pipe	Culvert	Lin. Ft.
6885	84	Reinforced Concrete Pipe	Culvert—Extra Strength	Lin. Ft.
6890	90	Reinforced Concrete Pipe	Culvert	Lin. Ft.
6891	90	Reinforced Concrete Pipe	Culvert—Extra Strength	Lin. Ft.
6802	102	Reinforced Concrete Pipe	Culvert	Lin. Ft.
6803	102	Reinforced Concrete Pipe	Culvert—Extra Strength	Lin. Ft.





**SECTION 69**  
**REINFORCED CONCRETE ARCHES**  
**AND UNDERPASSES**



**69.01 DESCRIPTION.** The materials and work covered by this section shall concern the furnishings and installation of reinforced concrete arch culverts, reinforced concrete underpasses, reinforced concrete stockpasses and any other similar prefabricated structures in conformity with the specifications, plans and the requirements of Section 60, "Pipe Culverts," or as may be directed by the engineer.

**69.02 MATERIALS AND MANUFACTURE.** (1) The provisions of this article are the same as those in Article 68.02, except as modified herein.

(2) Design and manufacture of specified underpasses, stockpasses and similar structures shall conform to provisions set forth on the plans, current standard drawings or otherwise stipulated.

**69.03 CONSTRUCTION METHODS.** Construction methods shall conform to the requirements of Article 60.03, Section 60.

**69.04 METHOD OF MEASUREMENT.** Methods of measurement shall be as provided in Article 60.06, Section 60.

**69.05 BASIS OF PAYMENT.** Payment shall be made in accordance with the provisions of Article 60.07, Section 60.

Item No.	Size	Item Description	Unit
6905	24"—18 x28½	Reinf. Conc.— Arch Culvert	Lin. Foot
6906	30"—22 1/2 x36¼	Reinf. Conc.— Arch Culvert	Lin. Foot
6907	36"—26 5/8 x43¾	Reinf. Conc.— Arch Culvert	Lin. Foot
6908	42"—31 5/16x51½	Reinf. Conc.— Arch Culvert	Lin. Foot
6909	48"—36 x58½	Reinf. Conc.— Arch Culvert	Lin. Foot
6910	60"—45 x73½	Reinf. Conc.— Arch Culvert	Lin. Foot
6911	72"—54 x88	Reinf. Conc.— Arch Culvert	Lin. Foot
6920	72"x48"	Reinf. Conc.— Underpass-Standard	Lin. Foot
6930	84"	Reinf. Conc.— Stockpass-Flat Bot.	Lin. Foot





## SECTION 70

### UNDERDRAINS AND SEWER TILE



**70.01 DESCRIPTION.** "Underdrains and Sewer Tile," or Pipe, conforming to these specifications and the plans and the requirements of Section 60, "Pipe Culverts" shall be furnished as specified or as may be directed by the engineer.

**70.02 MATERIALS AND MANUFACTURE.** Tile or pipe shall be one of the following types or kind and shall conform to the respective requirements set forth, except as these requirements may be herein supplemented or modified.

(a) Concrete or clay drain tile shall conform to the current requirements of the respective A.A.S.H.O. Designations M-65 or M-66.

(b) Concrete or clay drain tile of porous, perforated, or other design shall meet the pertinent requirements of the respective A.A.S.H.O. Designations M-65 or M-66.

(c) Corrugated metal pipe underdrains shall conform to the current requirements of A.A.S.H.O. Designation M-136.

(d) Concrete sewer tile or pipe shall conform to the requirements of the respective A.A.S.H.O. Designations M-86 or M-87.

**70.03 CONSTRUCTION METHODS.** Construction methods shall conform to the requirements for the pertinent type described in Section 60, "Pipe Culverts," except that the backfill for corrugated metal pipe underdrains shall meet the requirements for fine aggregate specified in Article 46.04, Subsection 46.00. Gradation shall conform to that shown in Table "B" of that Article.

Where shown on the plans, the top surface of the aggregate backfill shall be shaped as shown and sealed with a course of mortar approximately one (1) inch in thickness. The mortar shall consist of Portland cement and sand, mixed with water in the proportions of one (1) part of cement to five (5) parts of sand. The materials for the mortar will be subject to approval by the engineer before being used.

**70.04 METHODS OF MEASUREMENT.** Methods of measurement shall be as provided in Article 60.06, Section 60.

**70.05 BASIS OF PAYMENT.** Payment shall be made in accordance with the provisions of Article 60.07, Section 60.

Item No.	Item Description	Unit
7003	8" Concrete Sewer Pipe	Lin. Foot
7004	10" Concrete Sewer Pipe	Lin. Foot
7005	12" Concrete Sewer Pipe	Lin. Foot
7006	15" Concrete Sewer Pipe	Lin. Foot
7010	12" Reinforced Concrete Sewer Pipe	Lin. Foot
7011	15" Reinforced Concrete Sewer Pipe	Lin. Foot
7012	18" Reinforced Concrete Sewer Pipe	Lin. Foot
7013	21" Reinforced Concrete Sewer Pipe	Lin. Foot
7014	24" Reinforced Concrete Sewer Pipe	Lin. Foot
7015	27" Reinforced Concrete Sewer Pipe	Lin. Foot
7016	30" Reinforced Concrete Sewer Pipe	Lin. Foot
7017	33" Reinforced Concrete Sewer Pipe	Lin. Foot
7028	8" Clay Drain Tile—Standard	Lin. Foot
7029	10" Clay Drain Tile—Standard	Lin. Foot
7030	12" Clay Drain Tile—Standard	Lin. Foot
7031	15" Clay Drain Tile—Standard	Lin. Foot
7051	8" Corrugated Metal Pipe Underdrain—Type 1	Lineal Foot
7053	12" Corrugated Metal Pipe Underdrain—Type 1	Lineal Foot
7055	18" Corrugated Metal Pipe Underdrain—Type 1	Lineal Foot





## SECTION 71

### DITCH LINING AND FLUME





**71.01 DESCRIPTION.** "Ditch Lining and Flume" shall consist of the furnishing and erection of this type of structures in accordance with these requirements and the specifications and plans and/or as directed by the engineer.

**71.02 MATERIALS AND MANUFACTURE.** (a) Metal ditch lining and metal flume shall be made of twenty (20) gage (U. S. Standard) galvanized ferrous sheets and shall be of semi-circular type. The base metal and spelter coating shall comply with the physical and chemical requirements for "Corrugated Metal Culvert Pipe" as specified in Section 63. The completed flume or ditch lining shall consist of formed and beaded sheets, carrier rods, compression bars, shoes, anchor rods, nuts and washers, all of which shall be galvanized. The joints between successive sheets comprising the lining shall be designed to provide rigidity and water-tightness, and they shall offer the least possible resistance to flow.

Carrier rods, compression and anchor bars, shoes, nuts, washers and hanger plates shall have a galvanized coating of not less than three-fourths ( $\frac{3}{4}$ ) ounce of commercially pure zinc per square foot of surface. The coating shall be capable of withstanding three (3) one (1) minute and one (1) one-half ( $\frac{1}{2}$ ) minute dips in a standard testing solution of copper sulfate without showing any trace of metallic copper on the steel, in accordance with current requirements of A.A.S.H.O. Designation T-66.

The lumber for framing shall be graded, for the grade selected in accordance with grading rules which conform to the basic provisions of the "American Lumber Standards."

Use of the following listed species of wood will be allowed: Douglas Fir, West Coast Hemlock, Western Red Cedar, Ponderosa Pine and Larch. Douglas Fir of the Coast Region, West Coast Hemlock, and Western Red Cedar shall be graded by WMLC rules and Douglas Fir of the Rocky Mountain Region, Ponderosa Pine and Larch shall be graded by WPA rules.

(b) Timber Ditch Lining and Timber Flume shall be treated or untreated as specified in the plans and/or proposal and shall meet all the pertinent requirements of Section 43, "Timber Structures."

**71.03 CONSTRUCTION METHODS.** The framing, erection and completion of the structure shall be done in conformity with the appropriate provisions of Section 43 and in accordance with the plans.

The metal ditch lining and metal flume shall be laid true to line and grade, on a bed that is uniformly firm throughout its entire length. The separate sections shall be firmly jointed together with the outside laps of circumferential joints pointing upstream.

**71.04 METHOD OF MEASUREMENT.** Lumber used in the completed and accepted work will be measured in accordance with the respective requirement of Section 43.

Metal ditch lining and/or metal flume will be measured by the lineal foot of the completed and accepted work in place.

When ditch lining is used in conjunction with guide posts, the posts will be measured under Section 90.

**71.05 BASIS OF PAYMENT.** Lumber will be paid for at the contract unit bid price, which price and payment shall be full compensation for furnishing the lumber, hauling, handling, framing, erection, tools, labor, equipment and all incidentals necessary to complete the work.

When ditch lining is used in conjunction with guide posts the posts will be paid for under Section 90.

Metal ditch lining and/or metal flume will be paid for at the Contract unit bid price, which price and payment shall be full compensation for furnishing the lining and/or flume, hauling, handling, excavation and backfilling, unless otherwise specified, for erection and installation, anchors, anchor rods, wood carrier beams, shoes, nuts, bolts, stringers, labor, tools, equipment and all incidentals necessary to complete the work on either lining and/or flume, as the case may be.

Item Number	Item Description	Unit
7110	Metal Ditch Lining	Lineal Foot
7120	Metal Flume	Lineal Foot
7130	Untreated Timber Ditch Lining	M.b.m.
7140	Treated Timber Ditch Lining	M.b.m.
7150	Untreated Timber Flume	M.b.m.
7160	Treated Timber Flume	M.b.m.





## SECTION 72

### BITUMINOUS TREATED PIPE CULVERTS



**72.01 DESCRIPTION.** This Section pertains to corrugated metal pipe to which has been applied a bituminous coat or an asbestos-bonded bituminous coat of approved material in accordance with these specifications and/or the special provisions.

When such an item is stipulated in the proposal form it is meant that the item shall be furnished and installed in accord with the plans and specifications or as may be directed by the engineer.

**72.02 MATERIALS.** The corrugated metal pipe culvert to be treated, as prescribed in this section, shall conform to the requirements set forth in Section 63, "Corrugated Metal Pipe," or as may be modified by the special provisions.

**(1) Bituminous-coated Corrugated Metal Pipe.** Bituminous corrugated metal pipe shall be galvanized corrugated metal pipe that has been uniformly coated inside and out with asphalt cement to a minimum thickness of 0.05 inch, when measured at the crest of the corrugations, and subject to the following provisions:

**(a) Asphalt.** Asphalt for coating shall have the following properties:

	Limit Test Method Percent
Bitumen soluble in cold carbon tetrachloride not less than .....	99.5 AASHO T 45
Loss on heating to 163° C., not more than ....	1.0 AASHO T 47
Penetration of residue after heating compared with penetration of same sample before testing for loss on heating, not less than .....	85 AASHO T 49

**(b) Sampling.** All tests on the bituminous coating shall be made on samples obtained from the pipe on or about to be delivered to the project. A 5-ounce sample of the bituminous coating shall be obtained by gathering strippings from the inside top of one or more lengths of pipe. (Care shall be taken in sampling to avoid contamination from sand or soapstone that may have been applied after dipping).

**(c) Shock Test.** The ability of coated pipe to withstand handling in cold weather is indicated by successfully passing the following shock test:

**Apparatus.** The apparatus for the shock test shall consist essentially of a rigid metal anvil or base plate not less than ½ inch thick and resting on a solid foundation, and a hammer weighing 2,000 grams arranged to fall freely in a suitable guide against a plunger weighing 1,000 grams and sliding freely in a vertical sleeve. The lower end of the plunger shall be



hemispherically shaped with a radius of  $\frac{1}{2}$  inch. The hammer shall be held in its guide by a trip mechanism at a distance of  $5\frac{1}{8}$  inches above the plunger. Split molds for preparing the specimens shall be made of brass with the surfaces amalgamated to prevent sticking and held together by slip rings pressed on the slightly tapered outside surfaces.

**Procedure.** Four test specimens shall be prepared in the form of disks  $\frac{3}{8}$  inch thick and  $1\frac{3}{4}$  inch in diameter. Approximately 4 ounces of the material sample shall be heated over a low flame until it becomes fluid, then poured into a mold or molds. Care must be exercised to melt the sample at the lowest possible temperature. The sample shall be stirred thoroughly until it is homogenous and free from air bubbles when poured into the molds. The material may be poured in one  $1\frac{3}{4}$  inch diameter cylinder of such length that the four test specimens may be cut from it, using a wire cutter. Two of the samples used in the the shock test may be used later to prepare samples for the flow test.

The four specimens shall be cooled in a brine of ice and salt at a temperature of  $30^{\circ}\text{F.}$  for a period of at least 1 hour. The samples shall then be removed, one at a time, and quickly placed on the anvil of the test apparatus and centered under the plunger. The hammer shall then be tripped from a height of  $5\frac{1}{8}$  inches. Not more than 8 seconds shall elapse from the time each specimen is removed from the brine until the hammer strikes the plunger.

For material to be acceptable, not more than one of the four test specimens shall show a crack. If it is difficult to determine, visually, whether a specimen has cracked, it may be removed from the test apparatus and bent slightly.

**(d) Flow test.** The ability of the coating on the pipe to remain in place and not flow or sag at summer temperature is indicated by successfully meeting the following flow test;

**Apparatus.** The apparatus for the flow test shall consist of a corrugated brass plate 0.03 inch thick 8 inches long, and 4 inches wide, with corrugations running the long way of the plate and a metal support to hold the plate on a 45-degree angle with the horizontal. The corrugations shall have a crest-to-crest dimension of  $\frac{5}{8}$  inch and a depth of  $\frac{3}{16}$  inch. A line shall be scribed 6 inches from the lower edge. Split molds shall be similar to those specified above for the shock test.

**Procedure.** Two test specimens in the form of cylinders, each  $\frac{3}{8}$  inch in diameter and  $\frac{3}{4}$  inch in length, shall be obtained by pouring the excess molten bitumen from the shock test into the amalgamated brass molds. Each specimen shall be placed in a corrugation of the corrugated slide (slide to be on the 45-degree slope) so that the lower end of each specimen will rest exactly along a line scribed 6 inches from the bottom edge of the slide. The test apparatus, with the specimens in place, shall then be placed in an oven maintained at

150° (plus or minus 2°)F. After 4 hours it shall be removed and allowed to cool to room temperature. The distance from the bottom of the corrugated plate to the lower edge of each test specimen subtracted from 6 inches, determines the amount of sag or flow. To be acceptable, the flow must not exceed  $\frac{1}{4}$  inch for either of the two specimens.

(e) **Imperviousness Test.** The imperviousness of the coating shall be determined by placing 25 to 50 milliliters each of a 25 percent solution of sulfuric acid, a 25 percent solution of sodium hydroxide, and a saturated salt solution, in three adjacent corrugations for a period of 48 hours during which time no loosening or separation of the coating from the galvanizing shall have taken place.

(2) **Bituminous-coated paved invert corrugated metal pipe.** Bituminous-coated paved invert corrugated metal pipe shall be bituminous-coated corrugated metal pipe, conforming to the requirements in Paragraph (1) above, that has been paved with asphalt cement over the bottom one-fourth of its circumference. All valleys shall be filled and extended  $\frac{1}{8}$  inch above the crest of corrugations.

(3) **Asbestos-bonded corrugated metal pipe.** The galvanizing or spelter coating shall conform to the provisions of A.A.S.H.O. M 36 but shall be applied at such a rate per square foot that, when sampled in accordance with specified methods, the recoverable amount of spelter, after the asbestos-bond has been removed, shall be not less than 1.5 ounces per square foot of double exposed surface. Asbestos-bonded corrugated metal pipe shall be fabricated from asbestos-bonded sheets, the base metal of which shall conform to the requirements of Section 63. Both sides of the metal sheets shall be coated with a layer of asbestos fibers applied by pressing a sheet of asbestos fiber into the molten metallic bonding medium. Immediately after the metallic bond has solidified, the asbestos fibers shall be thoroughly impregnated with a bituminous saturant. The finished sheets shall be of first-class commercial quality, free from blisters and uncoated spots. After the asbestos-bonded sheets have been fabricated into culvert sections, the bituminous coating shall be applied in accordance with the requirements of Paragraph (1) above.

**72.03 CONSTRUCTION METHODS.** Construction methods shall conform to those prescribed in Section 60, "Pipe Culverts." The pipe culvert, when delivered on the project, shall be carefully inspected for abrasions and imperfections of the bituminous treatment. Defects of a consequence, in the opinion of the engineer, shall be just cause for rejecting any sections of such pipe culvert.

**72.04 METHOD OF MEASUREMENT.** Method of measurement shall be as provided in Article 60.06, Section 60.

**72.05 BASIS OF PAYMENT.** Payment shall be made in accordance with the provisions of Article 60.07, Section 60. No additional payment, over and above the price bid for furnishing and installing the pipe culvert, shall be allowed for bituminous coating, paved invert treatment or asbestos bonding.

The item numbers listed below will designate various types and sizes of corrugated metal pipe that may be specified.

Item Number	Item Description	Unit
7205	24" Corrugated Metal Pipe— Bituminous Coated	Lineal Foot
7206	24" Corrugated Metal Pipe— Asbestos Bonded	Lineal Foot
7207	30" Corrugated Metal Pipe— Bituminous Coated	Lineal Foot
7208	30" Corrugated Metal Pipe— Asbestos Bonded	Lineal Foot
7209	36" Corrugated Metal Pipe— Bituminous Coated	Lineal Foot
7210	36" Corrugated Metal Pipe— Asbestos Bonded	Lineal Foot
7211	42" Corrugated Metal Pipe— Bituminous Coated	Lineal Foot
7212	42" Corrugated Metal Pipe— Asbestos Bonded	Lineal Foot
7213	48" Corrugated Metal Pipe— Bituminous Coated	Lineal Foot
7214	48" Corrugated Metal Pipe— Asbestos Bonded	Lineal Foot
7216	54" Corrugated Metal Pipe— Bituminous Coated	Lineal Foot
7218	54" Corrugated Metal Pipe— Asbestos Bonded	Lineal Foot
7219	60" Corrugated Metal Pipe— Bituminous Coated	Lineal Foot
7220	60" Corrugated Metal Pipe— Paved Invert	Lineal Foot
7221	60" Corrugated Metal Pipe— Asbestos Bonded	Lineal Foot





**SECTION 74**

**CURBS, GUTTERS**  
**SIDEWALKS, HEADWALLS, ETC.**





**SUBSECTION 74.00 CURB AND GUTTER**

**74.01 DESCRIPTION.** "Curb and Gutter" shall consist of the construction of any of the types of curb, integral curb and gutter, median concrete curb and similar items and the furnishing and installing of precast concrete curb as stipulated in the proposal in accordance with these requirements and the plans, at those locations designated therein and/or as directed.

**74.02 MATERIALS.** When of Portland Cement Concrete, the materials shall conform to the requirements of Subsection 46.00, "Concrete" for the class of concrete specified. See applicable standard drawings.

Reinforcing steel shall conform to the requirements of Section 47, "Reinforcing Steel."

Materials for bituminous construction shall conform to the respective requirements of Section 30, "Bituminous Material," and Section 20, "Aggregate Surfacing for the type and grading specified."

**74.03 CONSTRUCTION METHODS.** Foundations for cast-in-place curb or curb and gutter shall be excavated and/or otherwise prepared in accordance with the pertinent requirements of Section 60, "Pipe Culverts."

Forms shall be either metal or straight grained finished lumber; in either case they shall be straight, free of warp or irregularities and of sufficient strength to resist springing or departure from true alignment and grade during the process of depositing of and/or following the placement of materials. Forms shall be full depth, securely staked and braced with headers and clamps. Contact surfaces of forms shall be clean and oiled to prevent adherence of materials and damage to surfaces in form removal.

Concrete shall be placed in the forms in uniform layers not to exceed six (6) inches loose depth, with each layer being thoroughly tamped and spaded, with approved tools and methods, next to the forms during the placing process to assure uniform maximum density and a smooth surface.

As soon as concrete has set sufficiently to retain its shape, forms shall be removed and honey-combed or rough surfaces shall be immediately corrected by use of 1:2 mortar. The concrete shall be floated with a wooden float, applying clean water ahead of the float when required to form a slurry. All form marks and other irregularities shall be completely removed by floating. Final surface finish shall be obtained by uniformly brushing the surface, using an approved type brush before the concrete sets. The edges of all concrete, including edges at expansion joints, shall be neatly edged to the required radii.

Concrete shall be cured by keeping it wet with water or applying curing compound as specified in Paragraph (15), Article 39.02, Section 39. If water is used, the concrete shall be kept wet for a period of seven (7) days following its finishing.

When finished, all types of curb and/or integral curb and gutter shall present clean, uniform surfaces and lines free of irregularities or distortions. When tested with a ten (10) foot straightedge, the alignment and grades shall not vary more than one-fourth ( $\frac{1}{4}$ ) inch from the plane.

When bituminous materials are used, the completed product shall be of maximum density in structure, present a smooth tight surface and conform to all alignment and grade requirements for concrete.

Slip forms and/or machines may be used when approved by the engineer, provided these methods will secure a completed product comparable in all respects to that obtained by the set-form method.

Precast curb shall be constructed of the class of concrete and in accordance with the requirements stipulated in the proposal and/or shown on the plans. Unless othrewise specified, precast curb shall conform to all the structural and finish requirements for cast-in-place curb. Precast curb shall be installed in accordance with the requirements shown on the plans and/or as directed.

**74.04 METHOD OF MEASUREMENT.** Curb, integral curb and gutter, median concrete curb and similar items will be measured by the lineal foot along the bottom of the curb line, including radii of completed and accepted work in place.

**74.05 BASIS OF PAYMENT.** Curb, integral curb and gutter, median concrete curb and similar items will be paid for at the contract unit bid price, which price and payment shall be full compensation for furnishing all materials, excavations, backfilling, removal of excess materials, setting the forms, finishing, expansion joint materials, dowel bars, labor, tools, equipment and all incidentals necessary to complete the work.

Item Number	Item Description	Unit
7402	Concrete Curb	Lineal Foot
7404	Integral Concrete Curb and Gutter	Lineal Foot
7406	Median Concrete Curb—Type 'A'	Lineal Foot
7408	Median Concrete Curb—Type 'B'	Lineal Foot
7410	Median Concrete Curb—Type 'C'	Lineal Foot
7412	Precast Concrete Curb	Lineal Foot
7414	Precast Concrete Curb and Gutter	Lineal Foot
7416	Concrete Cut-off Curb	Lineal Foot
7418	Concrete Gutter	Lineal Foot
7420	Bituminous Curb	Lineal Foot
7422	Bituminous Gutter	Lineal Foot

**SUBSECTION 74.50 CONCRETE SIDEWALK**

**74.51 DESCRIPTION.** "Concrete Sidewalk" shall consist of furnishing materials and constructing concrete sidewalks in conformity with the proposal, specifications, plans and standard drawings or as may be directed by the engineer.

**74.52 MATERIALS.** The materials for Portland Cement concrete sidewalks shall conform to the requirements of Subsection 46.00, "Portland Cement Concrete" for the class of concrete specified.

Reinforcing steel, if used, shall conform to the requirements of Section 47, "Reinforcing Steel."

**74.53 CONSTRUCTION METHODS. (1) Subgrade and Forms.** The subgrade shall be excavated to a depth of four (4) inches below grade, unless directed otherwise by the plans or by the engineer, and thoroughly settled and compressed by wetting and tamping. The contractor shall use suitable means to assure that grade lines are met and retained. Forming shall conform to the pertinent requirements of Article 74.03 of this Section and Article 46.05 of Subsection 46.00, "Portland Cement Concrete."

**(2) Concrete.** Concrete shall be prepared, mixed, placed, jointed, treated, cured and finished in accordance with the pertinent provisions of Subsection 46.00, Article 46.05. Reinforcing steel, if used, shall be placed as specified by the plans.

**74.54 METHODS OF MEASUREMENT.** Concrete sidewalks shall be measured by the square yard of completed sidewalk. Reinforcing steel, if used, shall not be measured.

**74.55 BASIS OF PAYMENT.** Payment for sidewalks will be made on the basis of the price bid per square yard. Payment for excavation of material not related to the construction of the sidewalk, but nevertheless necessary before the sidewalk can be placed, when and if shown on the plans, will be made in accordance with the pertinent provisions of Section 11, "Roadway, Drainage and Borrow Excavation." Otherwise the contractor shall make all excavations, regardless of depth, required for constructing the sidewalk to the lines and grades shown or directed, and shall include all costs thereof in the unit price bid for the item. Payment shall be full compensation for all costs and expense necessary or incidental to furnishing all labor, equipment, tools and materials, including reinforcing steel, in connection with excavating, loading, hauling and disposing of excavated materials, preparing the subgrade, placing, finishing, curing and protecting the sidewalk, furnishing and placing all joint material and for all other costs necessary to the completion of the work.

Item Number	Item Description	Unit
7454	Concrete Sidewalk—4"	Sq. Yd.
7455	Concrete Sidewalk—5"	Sq. Yd.
7456	Concrete Sidewalk—6"	Sq. Yd.

## SUBSECTION 74.60 CONCRETE HEADWALLS, RETAINING WALLS AND SUPPORTS

**74.61 DESCRIPTION.** The work contemplated under this subsection shall be the furnishing of materials and performance of work in connection with the construction of concrete headwalls, headgates, and supports of various types, all in conformity with the proposal, plans, current standard drawings, specifications and as may be directed.

**74.62 MATERIALS.** All concrete materials shall conform to the applicable requirements of Subsection 46.00, "Portland Cement Concrete" for the class of concrete specified. Reinforcing steel, if used, shall conform to the requirements of Section 47.

**74.63 CONSTRUCTION METHODS.** Excavation shall conform to the requirements of Section 60, insofar as applicable and as directed by the engineer. Methods concerning installation and construction of concrete structures shall conform to the applicable requirements of Subsection 46.00. Reinforcing steel, if used, shall be placed as specified by the plans or standard drawings.

**74.64 METHOD OF MEASUREMENT.** Measurement shall be in accordance with the applicable provisions of Subsection 46.00, Article 46.07. If any reinforcing steel is used, it shall not be measured, unless specified otherwise and so provided in the proposal form.

**74.65 BASIS OF PAYMENT.** Payment shall be made in conformity with the applicable provisions of Subsection 46.00, Article 46.08. If any reinforcing steel is incorporated in the structures it shall be considered as being included in the price bid for the item, unless specified otherwise and so provided in the proposal form.

Item Number	Item Description	Unit
7461	Concrete Headwalls for Pipe Culverts	Cubic Yd.
7463	Inlet and Outlet Headwalls for Corr. Met. Pipe	Cubic Yd.
7465	Inlet and Outlet Headwalls for Concrete Pipe	Cubic Yd.
7467	Concrete Supports for Pipe Culverts	Cubic Yd.
7469	Concrete Headgates	Cubic Yd.







## SECTION 75

MANHOLES, INLETS, CATCH BASINS, ETC.



**75.01 DESCRIPTION.** "Manholes, Catch Basins, Inlets, Etc.," shall consist of construction in place and/or the furnishing and installation of precast structures of any of the various types and designs of this classification in accordance with this specification and the requirements stipulated in the proposal and/or shown on the plans, at the locations designated therein and/or as directed.

**75.02 MATERIALS.** All materials used and/or any precast structures installed shall conform to the requirements stipulated in the proposal and/or shown on the plans.

**75.03 METHOD OF CONSTRUCTION.** Details of construction and/or installation of any structure will be stipulated in the proposal and/or shown on the plans.

Excavations shall be made to the required depth and the foundation or base upon which any structure is set shall be in accordance with the lines and grades established by the engineer. Foundations for the structures shall be prepared in such manner that the structure will have full contact and bearing of its base upon the foundation. Foundations shall be compacted in accordance with the density requirements set forth in Article 11.86, Subsection 11.80, "Embankment."

Backfill of the excavation around the structure shall be of suitable material deposited uniformly around the structure in layers not to exceed four (4) inches in depth with each layer being compacted in accordance with the foregoing requirements for density. Extreme care shall be exercised throughout the backfilling process to maintain the structure to the established lines and grades.

Where mortar is required for making connections and for any other work necessary to any of the structures, it shall be composed of one (1) part Portland Cement and two (2) parts sand meeting the requirements of fine aggregate set forth in Subsection 46.00, Article 46.04, Table 'B.'

**75.04 METHOD OF MEASUREMENT.** Measurement will be made on the basis of any of the various structures as a unit of each structure completed and accepted in place.

**75.05 BASIS OF PAYMENT.** Manholes, catch basins, inlets, etc., will be paid for at the contract unit bid price, which price and payment shall be full compensation for furnishing all materials required and/or the precast structure, as the case may be, for all excavation, backfilling, removal of excess material, mortar, connections, castings, reinforcing steel, adjustments, fittings, labor, tools, equipment and all incidentals necessary to complete the structure and the work.

Item Number	Item Description	Unit
7510	Combination Manhole and Catch Basin— Precast	Each
7520	Combination Manhole and Catch Basin— Cast in Place	Each
7530	Manhole—Precast	Each
7540	Catch Basin	Each
7550	Standard Drop Inlet	Each
7551	Double Drop Inlet	Each



**SECTION 79**

**FENCE AND FENCING**



**SUBSECTION 79.10 WIRE FENCE**

**79.11 DESCRIPTION.** "Wire Fence" shall consist of furnishing materials for and erection and construction of wire fences and metal gates in accordance with plans, specifications and standard drawings, or as directed by the engineer. Wire fence shall be of barbed wire or barbed wire combined with wire mesh, fastened to posts. A metal gate shall consist of a metal frame filled with wire mesh. See standard drawings for various types of fence.

**79.12 MATERIALS. A. General.** All materials used in the construction of the fence and gates shall be new and unused. All metal material shall be galvanized. Imperfectly galvanized material, or material upon which serious abrasions or galvanizing occur, shall not be used. The type of posts to be used shall be indicated by the proposal.

**B. Woven Wire.** The woven wire mesh design shall conform to the U. S. Department of Commerce Simplified practice recommendation R9-47 wherein the height is 32 inches; Design No. 832; 8 horizontal wires with top and bottom wires gage 9, and intermediate wires gage 11; stays gage 11 spaced at 6 inches. Woven wire fabric shall conform to the current standard specifications for "zinc-coated (galvanized) Iron or Steel Farm—Field and Railroad Right-of-Way Wire Fencing," A.S.T.M. Designation A-116. The base metal shall be copper bearing, and the minimum weight of zinc coating and the minimum number of dips in the Preece test for uniformity of zinc coating shall be as set forth for Class I or better fence.

**C. Barbed Wire.** Barbed wire shall conform to the current standard specifications for "Zinc-coated (galvanized) Iron or Steel Wire," A.S.T.M. Designation 121, and shall consist of two strands of gage 12½ wire, twisted with four-point 14-gage barbs spaced not more than five inches apart. The base metal shall be copper bearing. Zinc coating shall be as specified in Paragraph B, woven wire.

**D. Brace Wire.** Brace wire may be gage 9, soft. It will be used for constructing braces and panels, tying to anchors, etc. A satisfactory substitute will be the wire specified by Paragraph C—Barbed Wire.

**E. Staples.** The staples used to fasten the wire fencing to wooden posts shall be not less than gage 9, 1½ inches long.

**F. Tie Wires.** Tie wires shall be not lighter than gage 12½. Used for fastening barbed and woven wire to metal posts.

**G. Metal Fence Stays.** These shall be of standard make, made from wire base, gage 9, twisted to form a 2-wire unit.

**H. Metal Fence Posts and Braces.** Brace posts, end posts, gate posts, corner posts and braces shall be angle steel. Lengths shall be as shown on current standard drawings unless specified otherwise.

Angle steel posts shall be  $2\frac{1}{2}$ "x $2\frac{1}{2}$ "x $\frac{1}{4}$ " size, or heavier grade, braces shall be  $2\frac{1}{2}$ "x $2\frac{1}{2}$ "x $\frac{3}{16}$ " size, or heavier, finished like the posts. The posts and braces shall be fabricated from hot-rolled steel sections having tensile properties as set forth in Table SP-1.

All brace, end, gate, and corner posts used in constructing a specified type of fence on the project shall be of the same type.

Each brace, end, gate, or corner posts and each brace shall be set in concrete and braced as indicated on current standard drawings.

Line posts shall be fabricated from hot-rolled steel section conforming to the grade and strength requirements set forth in Table SP-1.

TABLE SP-1

Grade	Tensile Properties	
	Yield Strength	Ultimate Strength (lbs. per sq. in.)
Hot-rolled carbon steel, (min. carbon 0.35 percent).....	40,000	70,000
Hot-rolled rail steel.....	50,000	80,000

Line posts shall have a nominal weight of 1.33 pounds per foot, exclusive of anchor plate, and shall be of the length shown on the standard drawing, unless specified otherwise herein.

Line posts shall be Tee, H, Channel or U-bar section and shall have corrugations, knobs, notches, holes or studs so placed and constructed as to engage a substantial number of fence line wires in proper position. Posts with punched tabs for fastening wire are not acceptable. Each line post shall be provided with a steel anchor plate weighing not less than 0.67 pound and welded or riveted to the post in a position to place it below ground surface when the post is set to prescribed depth.

Whether posts with Tee, H, Channel or U-bar sections are used shall be optional with the contractor, but all line posts used in constructing a specified type of fence on the project shall be of the same type.

All posts, braces, anchor plates and fittings shall be galvanized in accordance with the requirements of A.S.T.M. Designation A-123 or A-153.

**I. Wood Fence Posts and Braces.** Posts and braces shall be made from Western Larch, Lodgepole Pine, Ponderosa Pine, Douglas Fir, Western Red Cedar, or equivalent product. They shall have the bark removed, be well seasoned, sound, and straight-grained.



Line posts shall be four-inch minimum diameter round, or equivalent sawn size. Corner, end, brace, and gate posts shall be six-inch minimum diameter, round or equivalent sawn size. Lengths shall be as specified on current standard drawings.

Any other timber or lumber used in the construction of the fence and its appurtenances shall conform, reasonably, to the above requirements.

Posts that are to be driven into the ground shall be tapered in twelve inches to a one-inch point for the lower end. The upper end shall be tapered for a minimum of four inches to a round top with a minimum diameter of three inches for line posts and five inches for corner, end, brace and gate posts; this taper is not included in the specified post length. Tapering shall be done prior to treatment. The requirement for extra length at the top will be waived, provided the contractor can drive the posts without damaging the upper end, as shall be decided by the engineer.

All posts and timber used in constructing the fence shall be treated as specified in Section 51, "Treated and Untreated Timber."

**J. Metal Gates.** Metal gates shall be plain-top single drive gates of galvanized, tubular steel frame with galvanized wire fabric filler. They shall be designed to fit openings between metal gate posts of the approximate widths called for by the plans or as indicated by the bid items in the proposal. Single drive gates for openings of less than 14 feet shall be provided with one centered steel upright brace; and for openings of 14 feet or more, with two similar upright braces spaced at third-points in the gate width. All gates shall be provided with one diagonal steel brace.

Metal gates shall be filled with galvanized standard mesh wire fabric as follows: (a) 2-inch diamond mesh, (b) 2-inch by 4-inch V-mesh, or (c) 2-inch by 4-inch rectangular mesh, as the contractor may elect. The horizontal wires of the fabric shall be gage 12½ or heavier; the cross wires of the fabric shall be gage 14 or heavier.

Metal gates used in conjunction with wire fence shall have a height of not less than 48 inches. The use of gates having greater heights will be permitted provided they do not extend above the top of gate posts.

The weight of gates shall be not less than the following:

Width of Opening	Minimum Weight
8	50 pounds
10	58 pounds
12	66 pounds
14	77 pounds
16	85 pounds

Each gate shall be furnished complete with necessary hinges and latch designed for use with the type of gate and gate post used on the project.

A "double gate" shall consist of two single drive gates of equal widths and conforming to the above requirements for metal gates, supported at their exterior ends by gate posts and provided with a double gate spring latch holder, a top double gate stop and a bottom double gate stop, or their equivalents, at the interior ends of the gates so designed as to permit the gates to be fastened securely in a closed position. The tube for holding the fastening rod of the bottom double gate stop shall be securely imbedded in concrete. The width designation of a double gate, as it appears in the proposal, is the approximate width of the opening, between gate posts, which the two single drive gates are to occupy when used jointly.

**K. Deadman or Anchor.** Deadman or anchors will be used at grade depressions, angle points and other places where unusual stresses will be exerted on the fence. A deadman shall weight at least 100 pounds and shall be buried in the ground with a cover of not less than two feet. It may be a single rock, Portland Cement concrete block, or other object or thing satisfactory to the engineer. An anchor may be (a) a steel or iron bar or rod, at least 1¼" diameter by 3 feet long, with provision on one end so that a brace wire can be securely retained, or (b) a section of galvanized metal line post at least 3 feet long, or (c) a substitute satisfactory to the engineer.

**L. Concrete.** Concrete used as footings for fence posts, braces, deadman and other similar purposes shall be Class "F" plain, as specified in Subsection 46.10.

**M. Miscellaneous.** Bolts, nuts, fittings, hinges, and all other metal parts used in the construction of fences and gates shall be galvanized in accordance with the applicable A.S.T.M. designation.

**79.13 CONSTRUCTION METHODS. A. General.** A "run" of fence shall be understood to mean the length of fence between brace panels or corner panels. The fence fabric and barbed wire shall be terminated at each brace panel, wrapped around the post and fastened to itself. A "run" shall not exceed 990 feet, or the length of three rolls of woven wire.

All fence shall be constructed at the locations and to the lines shown on the plans or ordered by the engineer. Openings for gates shall be provided where designated by the plans or by the engineer.

All trees, shrubs, brush, rocks and other obstacles which interfere with the proper construction of the fence shall be removed by the contractor and the materials so removed shall be disposed of in a manner satisfactory to the engineer.

When the fence is to be along right-of-way lines, fence posts are to be centered approximately 12 inches in from said lines and the wire fabric and barbed wire shall be placed, generally, on that face of the post which is away from the principle roadway. Where fence is on curved alignment, the fabric and wire shall be fastened to that face of the post against which the normal pull of the wires will be exerted (the outside of the curve).

Where existing fences join or intersect the new fence, an end or corner panel shall be placed in the line of the new fence at said junction and the existing fence wire and fabric shall be attached thereto in a workmanlike manner.

At each summit and at each valley in the grade of the fence where the algebraic difference in the grades of adjoining panels of fence exceeds 30 percent, brace panels shall be installed at critical points. When wood posts are used it may be necessary to install, in addition, deadmen or anchors as shall be decided by the engineer.

When the ground line is of such irregularity as to require brace panels at every other post or so, it will not be required that the wires be cut and terminated at each panel if a workmanlike job can be done to the satisfaction of the engineer.

In crossing coulees, ditches and abrupt depressions where the bottom line of the fence, as normally constructed, leaves an unfenced opening beneath it exceeding 12 inches in height, an additional panel or additional panels of fence between line posts shall be provided across said opening with barbed wire, fence fabric or combinations thereof, furnished as designated by the engineer, so that at no point along the fence will there be side openings or bottom openings exceeding 4 inches in dimension. Along ground of minor surface irregularity where the bottom line of the fence, as normally constructed, leaves an unfenced opening beneath it of 12 inches or less, the normal fabric and wires shall be pulled down between posts and anchored by means of iron pins, posts, or anchors driven not less than 36 inches into the ground so that at no point along the fence will there be any bottom opening exceeding 4 inches in height.

When and where the fence line crosses drainage courses, where there is probability that trash and debris will be washed against the fence during a heavy run-off, a special design shall be followed. There will be a drainage structure under the roadway in all such cases. The fence will, under these circumstances, be laid out similar to the plan, shown on the standard drawing, for fence layout at drainage structures. The resultant layout will be such that there will be no fence across the courses of runoff. The engineer shall decide where to make this type of installation.

**B. Posts.** Line posts shall be spaced at intervals not to exceed 16.5 feet. All intervals shall be measured center to center of posts. In general, in determining the spacing of posts, measurements will be made parallel to the existing ground and all posts shall be placed in a vertical position except where otherwise directed by the engineer.

Metal line posts may be driven in place, provided the method of driving does not damage the post. Metal corner, gate, end, and brace posts shall be set in Class "F" concrete footings of the dimensions shown on the standard drawing.

Wood posts may be placed in dug, drilled, or punched holes or may be driven into position, as decided by the engineer upon an inspection of soil conditions. If and when the hole is dug, drilled, or punched it shall be large enough to permit efficient use of tamping bars or mechanisms. The backfill around the post shall be firmly and thoroughly tamped so that the post is solidly imbedded in the ground. Improperly or inadequately tamped posts shall be removed and reset to the satisfaction of the engineer. The engineer shall decide whether driving posts into the ground will be acceptable. If the top of a driven post becomes damaged it shall be sawed off, at the specified height above the ground and the sawed area thoroughly painted with creosote oil or material equal to that used in the original treatment. Length of post shall be as specified on standard drawings. Regardless of which method is used in placing posts, the result shall provide an undamaged post set true to line and vertical position. It will be necessary to use deadmen or anchors, in some places, to hold the post to ground line.

Where solid rock is encountered, without an overburden of soil, line posts shall be set a minimum depth of 10 inches and end, corner, gate and brace posts a minimum depth of 16 inches into the solid rock. The hole shall have a minimum dimension one (1) inch greater than the largest dimension of the post section to be set. The posts shall be cut, before installation, to lengths which will give  $4\frac{1}{2}$  feet of post above ground or, if the contractor so elects, he may use 6-foot posts set 18 inches into the solid rock. After the post is set and plumbed, the hole shall be filled with grout consisting of one part Portland Cement and three parts clean, well-graded sand, or with Class "F" concrete. The grout shall be thoroughly worked into the hole so as to leave no voids. Where posts are set in the above manner, anchor plates and concrete footings will not be required.

Where solid rock is covered by an overburden of soil or loose rock, the posts shall be set to the full depth shown on the standard drawing unless the penetration into solid rock reaches the minimum depths specified above, in which case the depth of penetration may be terminated. When the depth of the overburden is greater than 12 inches anchor plates will be required on the metal line posts, and concrete footings shall be constructed from the solid rock to the top of the ground on metal end, gate, corner and brace posts. When the depth of overburden is 12 inches or less, anchor plates and concrete footings will not be required. Grouting will be required on the portion of the post in solid rock.

Metal braces shall be anchored to soil or loose rock with a Class "F" concrete footing as shown on the standard drawing, and set in solid rock to a minimum depth of 10 inches in



the same manner as specified above for posts. The braces shall be set on the diagonal as shown on the standard drawing and connected to the post with an approved connection.

Wood braces shall be dapped  $\frac{1}{4}$  inch into the posts and shall be fastened to each post with three 20d galvanized nails. The top of the brace shall be 12 inches below the top of the post, and the bottom 6 inches above the ground line.

When treated timbers are cut, dapped, drilled, or sawed, the exposed area, at the entrance area of bolts or nails, shall be painted with two coats of hot creosote oil.

Wire tension braces shall consist of material specified under Paragraph D—Brace Wire, Article 79.12. The wire shall be passed around the wood posts to form a double wire. The wire shall be fastened to each post with two staples and fastened together to form a continuous wire. The wires shall then be twisted together until the wire is in tension.

Where the new fence joins an existing fence, the two shall be attached in a manner satisfactory to the engineer, end or corner posts being set as necessary.

Brace panels to be used for pulling or wire stretching shall be spaced not more than nine-hundred-ninety (990) feet apart, but spacing shall be such as to use standard rolls of wire mesh with a minimum of splicing, cutting and waste.

Changes in alignment of 30 degrees or more shall be considered as corners, and brace or corner panels shall be installed. Where it is deemed by the engineer that a change in alignment of less than 30 degrees will materially lessen the strength of the fence, the line post at the angle shall be supported by the addition of braces and/or wires in a manner satisfactory to the engineer.

At grade depressions and alignment angles where stresses tending to pull posts from the ground are created, the wire fence shall be snubbed or guyed at the critical points by brace wire attached to each horizontal line of fence wire, and the end of the combined strands being firmly attached to a dead-man located at a point which will serve best to resist the pull of the wire fence. When metal posts are used, brace panels will be satisfactory if properly spaced and located to prevent the fence pulling up or out of line.

The current standard drawing shall be consulted and followed whenever and wherever practicable.

**C. Barbed Wire and Wire Mesh.** After the brace, end, and corner panels have been placed and securely braced, the barbed wire and mesh shall be laid in place and pulled tight, to the satisfaction of the engineer, and each longitudinal wire shall be cut and securely fastened to the "pull" post with devices customarily used for the purpose. Wire or mesh shall not be carried past a "pull" post but shall be terminated, wrapped around the post and fastened to itself, in addition to being fastened to the post.



After tensioning of the wire or mesh between two "pull" posts, all longitudinal wires shall be properly fastened at proper height to each intervening line post. All wires along the fence line shall be completed snug and tight.

Where unusual ground depressions occur between posts, the fence shall be guyed to the ground by brace wire attached to a deadman or anchor or double anchor. The brace wire shall be securely attached to each strand of barbed wire and to the top and bottom wires of the wire mesh fabric in a manner to maintain the entire fence in its normal shape. If necessary to guy the fence in solid rock, the brace wire shall be grouted in a hole about 2 inches in diameter and 10 inches deep. The operation of guying shall leave the fence snug with the ground.

When a "run" terminates or begins at a stock guard, which has a prefabricated metal wing, it will be necessary to run both barbed and mesh wire to both sides of the wing.

**D. Metal Fence Stays.** Metal fence stays shall be installed midway between posts, as a general rule. The wire shall be twisted in such a manner as to permit weaving into the horizontal fence wires to provide rigid spacing. All barbed wires and the top, middle and bottom wire of the mesh shall be woven into the stay.

**E. Gates.** Gates shall be installed in a workmanlike manner and with hinge-pintles and hinge clamps so designed and placed as to permit the swinging of the gate through an arc of 90 degrees inward and 90 degrees outward. Where gate openings of 16 feet or less are indicated on the plans or are called for by the engineer, the gate installed for such opening shall be one single drive gate designed to fit such opening. Where gate openings of more than 16 feet are indicated on the plans or are called for by the engineer, the gates installed for such opening shall be two single drive gates of equal width designed to fit such opening when used jointly as a "double gate."

**F. Concrete.** The concrete to be used as anchor for metal fence posts, braces and similar purposes shall be Class "F," plain. Where concrete is to be used for post or brace anchors, a hole of minimum dimensions as shown on the standard drawing shall be dug in the ground at the proper location. Forming will not be required if the earth will retain a shape satisfactory to the engineer. The mixed concrete shall then be poured into the hole, and the post or brace put in place before the concrete sets. Care shall be taken to assure that posts and braces remain in alignment while the concrete is setting.

**79.14 METHODS OF MEASUREMENT.** A. Measurement of wire fence shall be the number of lineal rods of completed fence, measured horizontally from outside to outside of end posts, exclusive of gates. If it is necessary, in crossing depressions, to install a double section of fence, vertically, this extra section shall be measured for payment.

B. Gates shall be measured on a unit basis, as indicated in the proposal form.

Whether the opening is closed by a single or double gate, it shall be considered to be one gate.

C. Corner panels and brace panels consisting, each, of three posts, two braces, brace wire and incidentals but not including the fence wire, shall be considered a unit as bid. End panels also shall be considered to be a unit. When the posts are metal, requiring concrete footings, such concrete shall be considered to be part of the panel. The term "fence panel" in the proposal form shall be interpreted to mean either "end panel," "corner panel" or "brace panel."

**79.15 BASIS OF PAYMENT.** A. Combination wire mesh and barbed wire fence shall be paid for on a lineal rod basis, measured as specified above.

B. Gates shall be paid for on a unit basis commensurate with the bid item.

C. Fence panels, as defined above, shall be paid for on a unit basis commensurate with the bid item.

Payment for the various items specified above shall be full compensation for furnishing all labor, materials, tools and equipment necessary or incidental to the construction of the complete fence and gates, including excavation, backfilling, deadmen, anchors, tamping, concrete footings, miscellaneous hardware, smoothing the irregularities of the ground at the fence site, clearing the line for the fence or stock guards, and disposing of all debris—all to the satisfaction of the engineer.

Wire fence and appurtenances shall be placed in several types for administrative and reference purposes. The types shall be as follows:

---

---

Type F-3-W Wire Fence—3 barbed wires with wooden posts.

Type F-3-M Wire Fence—3 barbed wires with metal posts.

Type F-4-W Wire Fence—4 barbed wires with wooden posts.

Type F-4-M Wire Fence—4 barbed wires with metal posts.

Type F-5-W Wire Fence—5 barbed wires with wooden posts.

Type F-5-M Wire Fence—5 barbed wires with metal posts.

Wooden Fence Panel—Wooden posts.

Metal Fence Panel—Metal posts.

Type C-W Wire Fence—3 barbed wires and 32" woven wire with wooden posts.

Type C-M Wire Fence—3 barbed wires and 32" woven wire with metal posts.

Type G-1 Gate—16 foot, wooden.

Type G-2 Gate—16 foot, 4 barbed wires.

Type M-1 Gate—Metal gate, opening size as specified, single.

Type M-2 Gate—Metal gate, opening size as specified, double.

Item Number	Item Description	Unit
7902	Type F-3-W Wire Fence	Rod
7904	Type F-3-M Wire Fence	Rod
7906	Type F-4-W Wire Fence	Rod
7908	Type F-4-M Wire Fence	Rod
7910	Type F-5-W Wire Fence	Rod
7912	Type F-5-M Wire Fence	Rod
7914	Type C-W Wire Fence	Rod
7916	Type C-M Wire Fence	Rod
7918	Wooden Fence Panel	Each
7919	Metal Fence Panel	Each
7920	Type G-1 Gate	Each
7921	Type G-2 Gate	Each
7922	Type M-1 Gate— 4 foot	Each
7923	Type M-1 Gate— 6 foot	Each
7924	Type M-1 Gate— 8 foot	Each
7925	Type M-1 Gate—12 foot	Each
7926	Type M-1 Gate—14 foot	Each
7927	Type M-1 Gate—16 foot	Each
7928	Type M-2 Gate—16 foot	Each
7929	Type M-2 Gate—20 foot	Each
7930	Type M-2 Gate—24 foot	Each
7931	Type M-2 Gate—28 foot	Each
7932	Type M-2 Gate—32 foot	Each

## SUBSECTION 79.40 STOCK GUARDS

**79.41 DESCRIPTION.** "Stock Guards" shall consist of structures placed in a line of fence, across approaches and roads leading to the roadway, to prevent the straying of livestock onto the highway, but not obstructing the free passage of vehicular traffic. Stock guards shall be furnished and installed at the locations shown on the plans, or as directed by the engineer, in accordance with these specifications. Each stock guard shall be equipped with two wings unless specified otherwise. "Cattle guard" and "auto gate" are two synonymous terms.

**79.42 MATERIALS. (1) Concrete.** The concrete for the base of the stock guard shall be Class "A" conforming to the requirements of Subsection 46.00, "Portland Cement Concrete." An air-entraining agent shall be added in conformity with the pertinent provisions of that subsection.

**(2) Structural Steel.** All structural steel shall meet the requirements of Section 48, "Structural Steel," except that crossbars shall be low-alloy A.S.T.M. Designation A-242 weldable steel. All other steel shall be structural carbon steel A.S.T.M. Designation A-373.

**(3) Reinforcing Steel.** All reinforcing bars shall be of intermediate grade billet steel. Deformations shall conform to A.S.T.M. Specification A-305 except as otherwise approved. Bends in reinforcing bars shall be made to a radius not less than four diameters of the bar except for stirrups and tie bars which shall be bent around a pin having a diameter of not less than two bar diameters. Hooks shall conform to dimensions shown on current standard drawings.

**(4) Wings.** Wings connecting the stock guard to the fence shall be as specified on the current standard drawing.

**(5) Paint.** All metal parts shall receive one shop coat of red lead conforming to the provisions of Section 54.

**(6) General.** A standard manufactured stock guard of equivalent strength, with suitable clean-out provisions, may be used if approved by the engineer. All details must be submitted to and approved by the engineer prior to fabrication and before footing elevations are set. All designs must provide for Standard H-20 loading.

**79.43 CONSTRUCTION METHODS. (1)** The concrete base shall be constructed to the lines and grades provided by the engineer and in conformity with the current standard drawing. Forms used in constructing the base and methods of mixing the concrete shall conform to the pertinent provisions of Subsection 46.00, Article 46.05 and the current standard drawing. Finishing of the concrete shall be in accordance with the provisions of Article 46.05, Paragraph (m), finishing concrete, except that stringer bearing surfaces must be finished to allow full bearing under each stringer. Any uneven surfaces will be bush-hammered, as directed by the engineer, until the stock guard rests on the concrete without rocking or warp.

**(2) Stock Guard.** The metal structure shall be placed upon the concrete base indicated by the standard drawing, or as directed by the engineer, and securely fastened thereto.

**(3) Wings.** The metal wings shall be affixed to the stock guard and connected to the fence as indicated by the standard drawing.

**(4) Painting.** All metal parts shall receive two field coats of paint consisting of first field or primer coat and one coat of aluminum paint in accord with the provisions of Section 54, "Paints for Wood and Metal," and Section 42, "Steel Bridges," Article 42.10, Painting.



(5) **Backfill.** Backfill around the completed structure shall be as directed by the engineer. Clean-up shall be included in requirements.

**79.44 METHODS OF MEASUREMENT.** Stock guards shall be measured as a complete unit, as indicated in the proposal. The concrete base shall be considered to be a part of the unit.

**79.45 BASIS OF PAYMENT.** The lump sum bid price for the stock guard, complete in place, shall be full compensation for all structural steel, hardware, paint, concrete, reinforcing steel, structure excavation, backfill, equipment, tools, labor and all incidentals necessary to complete the structure ready for use.

Item Number	Item Description	Unit
7945	24 ft. Stock Guard	Each
7950	36 ft. Stock Guard	Each

## SUBSECTION 79.60 CHAIN LINK FENCE

**79.61 DESCRIPTION.** "Chain Link Fence" shall consist of chain link wire mesh fence, including gates, supported on pipe framework, furnished and constructed in accordance with these specifications, plans, current standard drawings and as directed by the engineer.

**79.62 MATERIALS. 1. General.** All material used in the construction of the fence shall be new and galvanized. Imperfectly galvanized material, or material upon which serious abrasions of galvanizing occur, will not be acceptable. Used, re-galvanized or open seam posts or rail will not be accepted.

Posts, braces, top rails and gate frames shall be galvanized in accordance with the requirements of A.S.T.M. Designation A-120 or A-123. Fittings, attachments and hardware shall be galvanized in accordance with the requirements of A.S.T.M. Designation A-153. Other materials shall be galvanized as specified hereinafter.

The base material for the manufacture of steel pipes used for posts, braces, top rails and gate frames shall conform to the requirements of A.S.T.M. Designation A-53. The base material for the manufacture of steel "H" columns shall be good commercial quality weldable steel meeting the requirements of A.S.T.M. Designation A-7.

**2. Posts.** All posts shall be hot-dip galvanized.

Line posts for Type 1 and 2 fence shall be 2 inch x 2¼ inch "H" column with minimum weight of 4.1 pounds per lineal foot; for Type 3 and 4 fence shall be 1½ inch x 1⅞ inch "H" column with minimum weight of 2.80 lbs. per lineal foot.



Gate posts shall be  $3\frac{1}{2}$  inches nominal diameter pipe with minimum weight of 9.1 pounds per lineal foot.

End, corner and "pull" posts (braced line posts) for Type 1 and 2 shall be  $2\frac{1}{2}$  inches nominal diameter pipe with minimum weight of 5.79 pounds per lineal foot; for Type 3 and 4 fence shall be 2 inches nominal diameter with a minimum weight of 3.65 pounds per lineal foot.

All posts shall be fitted with an approved top so designed as to fit securely over the post and carry the top rail or cable. The base of the top fitting shall carry an apron around the outside of the post.

Length of post will be as shown on current standard drawings.

**3. Top Rails.** Top rails shall be hot-dip galvanized pipe  $1\frac{1}{4}$  inch nominal diameter, minimum weight 2.27 pounds per lineal foot, or  $1\frac{1}{2}$  inch x  $1\frac{5}{8}$  inch "H" column, minimum weight 2.0 pounds per lineal foot. Couplings shall be outside sleeve type and at least seven inches long. One coupling in every five shall contain a heavy spring to take up expansion and contraction of the top rail.

**4. Cable.** Top tension cable shall be  $\frac{3}{8}$  inch diameter hot-dip galvanized 7-strand steel cable conforming to the requirements of A.S.T.M. Designation A-122, Common Grade, galvanizing shall be Class "A."

**5. Cable Attachments.** All cable attachments shall be hot-dip galvanized steel unless otherwise specified. Shoulder eye bolts shall be  $\frac{5}{8}$  inch diameter and of sufficient length to fasten to the type of posts used. Turnbuckles shall be of the shackle end type,  $\frac{1}{2}$  inch diameter, with standard takeup of 6 inches and provided with  $\frac{3}{8}$  inch diameter pins. Thimbles shall be light weight wire rope thimbles for use with  $\frac{3}{8}$  inch diameter cable. Wire rope clips shall have a U-bolt diameter of  $\frac{7}{16}$  inch for use with  $\frac{3}{8}$  inch diameter cable. Anchor shackles shall be  $\frac{3}{8}$  inch diameter with a minimum distance between eyes of  $\frac{11}{16}$  inch and a pin diameter of  $\frac{7}{16}$  inch. Seizing shall be gage 26 galvanized annealed iron wire.

**6. Braces and Truss Rods.** Compression braces shall be hot-dip galvanized material of the same type and size as the top rail. Tension truss rods shall be  $\frac{3}{8}$  inch round galvanized rods with drop forged turnbuckles, or other approved type of adjustment.

**7. Fittings.** Fittings shall be hot-dip galvanized malleable cast iron or pressed steel. Fittings for any particular fence shall be those furnished by the manufacturer of the fence.

**8. Fence Fabric.** The fabric shall consist of gage 11 wire for Type 3 and 4 fences and gage 9 wire for Type 1 and 2 fences. It shall be woven into approximately 2 inch diamond mesh and shall meet all the requirements of A.S.T.M. Designation A-392. Galvanizing shall be Class I and shall be done after weaving.

The width of the fabric shall be as specified or shown on current standard drawings.

Chain link fabric shall be finished at top and bottom as shown on the standard drawing, either with a "twisted and barbed" selvage or "knuckled" selvage. Barbing shall be done by cutting the wire on the bias.

**9. Fabric Bands and Stretcher Bars.** Fabric bands shall be not less than  $\frac{1}{8}$  inch x  $\frac{3}{4}$  inch in section and stretcher bars not less than  $\frac{1}{4}$  inch x  $\frac{3}{4}$  inch in section. Both shall be hot-dip galvanized steel.

**10. Tie Wire.** Tie wire shall be gage 9 galvanized iron or aluminum wire.

**11. Gates.** Gate frames shall be constructed of hot-dip galvanized pipe of sizes and weights shown below. The corners of the gate frame shall be fastened together and reinforced with a malleable iron fitting designed for the purpose, or they may be welded. Welding shall conform to the requirements of Section 42, Article 42.05.

Single gate frame, 6 ft. and 8 ft. wide— $1\frac{1}{4}$  in. nom. dia. 2.27 lbs./ft.

Single gate frame, over 8 ft. wide  $1\frac{1}{2}$  in. nom. dia. 2.72 lbs./ft.

Cross trussing shall be  $\frac{3}{8}$  inch galvanized iron adjustable rods.

Chain link fence fabric for filling the gate frame shall meet the requirements specified in Paragraph 8 of this article.

Each gate shall be furnished complete with necessary hinges, latch, and drop bar locking device designed for the type of gate posts and gate used on the project.

Gates with frames constructed of steel sections, other than the pipe specified above and fabricated in such a manner as to form a gate of equal or better rigidity, may be used provided they are approved by the engineer.

**79.63 CONSTRUCTION METHODS. 1. Posts.** Posts shall be spaced at not more than 10-foot intervals. All intervals shall be measured center to center of posts. In general, in determining the post spacing, measurement will be made parallel to the slope of the existing ground and all posts shall be placed in a vertical position except where designated otherwise by the engineer.

All posts on Types 1 and 2 fence, and the end posts, anchor line posts and pull posts on Types 3 and 4 fence shall be set in Class "F" concrete (Subsection 46.10) to the dimensions shown on the standard drawing. All concrete footings shall be crowned so as to shed water. Line posts, except anchor line posts, on Types 3 and 4 fence shall be set in undisturbed earth either by driving or drilling. Driving shall be accomplished in such a manner as not to damage the post. Any voids around the post shall be backfilled with suitable material and thoroughly tamped.

Where solid rock is encountered without an overburden of soil, line posts shall be set a minimum depth of 14 inches, and end corner, gate and pull posts a minimum of 20 inches into the solid rock. The hole shall have a minimum width or diameter of one inch greater than the largest dimension of the post section to be set. The posts shall be cut, before installation, to lengths which will give the required length of post above ground, or if the contractor so elects he may use an even length of post set at greater depth into the solid rock.

After the post is set and plumbed the hole shall be filled with grout consisting of one part Portland cement and three parts clean, well graded sand. The grout shall be thoroughly worked into the hole so as to leave no voids and shall be crowned to carry water away from the post. Where posts are set in the above manner, concrete footings will not be required.

Where solid rock is covered by an overburden of soil or loose rock, the post shall be set to the full depth shown on the standard drawing unless the penetration into solid rock reaches the minimum depths specified above, in which case the depth of penetration may be terminated. Concrete footings shall be constructed from the solid rock to the top of the ground on Types 1 and 2 fence and on end, pull and anchor line posts on Types 3 and 4 fence. Grouting will be required on the portion of the post in solid rock.

"Pull posts" as used in these specifications shall be line posts braced to adjacent line posts in the manner shown on the standard drawing and spaced at 500-foot maximum intervals.

End, gate, and end pull posts shall be braced to the adjacent line post, and corner and pull posts to the two adjacent line posts in the manner shown on the standard drawing. Changes in line of 30 degrees or more shall be considered as corners.

**2. Top Rail—Type I Fence.** Top rails shall pass through the ornamental tops of the line posts, forming a continuous brace from end to end of each stretch of fence. Lengths of top rail shall be jointed by sleeve type couplings. Top rails shall be securely fastened to terminal posts by pressed steel fittings.

**3. Top Tension Cable—Types 2, 3 and 4 Fence.** Top tension cable shall pass through the ornamental top of the line posts. One continuous length of cable shall be used between pull posts. The cable shall pass through the pull post top and down to the base of the next line post where it shall be attached to the base of the line post with a turnbuckle in the manner shown on the standard drawing. Sufficient tension shall be applied to the cable to allow a maximum sag of  $\frac{1}{4}$  inch between posts after the chain link mesh has been attached to the cable. The contractor shall provide temporary bracing on pull posts when applying tension to one length of cable at a time, to prevent undue stresses in the pull post.

After tension has been applied to the cables, a wire rope clip shall be placed around both cables, one on each side of the pull posts, and the clips securely tightened. Clips shall be placed as close to the posts as possible to minimize the deflection of the post if one of the cables should be parted.

The cable shall be fastened to the top of the end pull post with an eye-bolt through the post and a turnbuckle connecting the eye-bolt to the cable. The end pull post shall be braced to the bottom of the end post with a short length of cable attached as shown on the standard drawing. A length of cable shall connect the end pull post and the end post at the top and shall be connected to the posts as shown on the standard drawing.

Eye-bolts shall have a shoulder on the eye end and shall be provided with a nut and lock washer. Where the eye-bolt is to be installed through a pipe section, two lead washers shall be placed against the shoulder of the eye, and a lead washer backed and the nut tightened sufficient to seal the hole in the pipe.

A galvanized iron strap  $\frac{1}{4}$  inch in thickness by 2 inches in width, formed as shown on the standard drawing, shall be provided for the attachment of eye-bolts to the base of the "H" column post in order to take the strain of the cable tension off the web of the "H" column.

All holes drilled in the post sections shall be cleaned and painted, as hereinafter specified in Paragraph 5 for welded areas on gates, before the eye-bolts are installed.

The ends of all cables shall be seized with annealed iron wire passed around the end of cable and the line cable as shown on the standard drawing. The seizing shall be at least one inch in width.

**4. Fence Fabric.** Chain link fabric on Type 1 fence shall be placed on the face of the post away from the highway, and on Types 2, 3 and 4 fence on the face of the posts designated by the engineer, except that on curves the fabric on all types of fence shall be placed on the face of the post which is on the outside of the curve.

The chain link fabric on Type 1 fence shall be placed approximately 1 inch above the ground and on a straight grade between posts by excavating high points of ground. Filling of depressions will be permitted only upon approval of the engineer. The fabric on Types 2, 3 and 4 fence shall be placed above the ground at the height shown on the standard drawing.

The fabric shall be stretched taut and securely fastened to the posts. Fastening to end, gate, corner, and pull posts shall be with stretcher bars and fabric bands spaced at one foot intervals. The fabric shall be cut and each span attached independently at all pull and corner posts. Fastening to line posts shall be with tie wire, metal bands or other approved method, attached at 14-inch intervals. The top edge of the fabric shall be fastened to the top rail with tie wires spaced at 18-inch intervals, or to the top tension cable with tie wires placed at 30-inch intervals.



Rolls of wire fabric shall be joined by weaving a single strand into the ends of the rolls to form a continuous mesh.

If and when a stock guard with wings is placed in a line of chain link fence, the wire fabric shall be extended beyond the post supporting the wing to both sides of the wing in a neat, workmanlike manner, and securely fastened thereto to the satisfaction of the engineer.

**5. Gates.** Chain link fabric shall be fastened to the end bars of the gate frame by stretcher bars and fabric bands, and to the top and bottom bars of the gate frames by tie wires in the same manner as specified hereinbefore for the chain link fence fabric; or by other standard methods if approved by the engineer.

Welded connections on gate frames, where the spelter coating has been burned, shall be thoroughly cleaned by wire brushing and all traces of the welding flux and loose or cracked spelter removed. The clean areas shall then be painted with two coats of zinc oxide-zinc dust paint compounded in a suitable vehicle in the ratio of one part zinc oxide to four parts zinc dust by weight.

The drop bar locking device for the double metal gates shall be provided with a 12-inch square by 15-inch deep footing of Class "F" concrete, crowned at the top and provided with a hole to receive the locking bar. The depth of the penetration of the locking bar into the footing shall be as specified by the manufacturer of the locking device.

The height of gate frame shall be approximately as follows:

Fence Type 1—5'6"

Fence Type 3—3'6"

Fence Type 2—4'6"

Fence Type 4—3'6"

**79.64 METHOD OF MEASUREMENT.** Chain link fence will be measured, horizontally, by the lineal foot of completed fence, exclusive of openings.

Measurement of metal gates shall be on a unit basis, as indicated in the proposal form and in the item number tabulation in the following article.

Stock guards shall be paid for on a unit basis, as indicated in the proposal form and in Subsection 79.40.

**79.65 BASIS OF PAYMENT.** Payment for the various items listed below shall be full compensation for furnishing all labor, materials, tools and equipment necessary or incidental to the construction of the completed fence and gates, including excavation, backfilling, tamping, concrete footings, omitting irregularities in the ground along the fence line, clearing the line and disposing of debris—all to the satisfaction of the engineer. Stock guards will be paid for under Subsection 79.40.



Item Number	Item Description	Unit
7961	Chain Link Fence—Type 1	Rod
7962	Chain Link Fence—Type 2	Rod
7963	Chain Link Fence—Type 3	Rod
7964	Chain Link Fence—Type 4	Rod
7965	Single 6 foot Gate—Type 1	Each
7966	Double 6 foot Gate—Type 1	Each
7967	Single 8 foot Gate—Type 1	Each
7968	Double 8 foot Gate—Type 1	Each
7969	Single 10 Foot Gate—Type 1	Each
7970	Double 10 foot Gate—Type 1	Each
7971	Double 12 foot Gate—Type 1	Each
7972	Double 14 foot Gate—Type 1	Each
7973	Single 6 foot Gate—Type 2	Each
7974	Double 6 foot Gate—Type 2	Each
7975	Single 8 foot Gate—Type 2	Each
7976	Double 8 foot Gate—Type 2	Each
7977	Single 10 foot Gate—Type 2	Each
7978	Double 10 foot Gate—Type 2	Each
7979	Double 12 foot Gate—Type 2	Each
7980	Double 14 foot Gate—Type 2	Each
7981	Single 6 foot Gate—Type 4	Each
7982	Double 6 foot Gate—Type 4	Each
7983	Single 8 foot Gate—Type 4	Each
7984	Double 8 foot Gate—Type 4	Each
7985	Single 10 foot Gate—Type 4	Each
7986	Double 10 foot Gate—Type 4	Each
7987	Double 12 foot Gate—Type 4	Each
7988	Double 14 foot Gate—Type 4	Each

Note: See Article 79.63, Paragraph 5. Type 3 and Type 4 gates are same height.





## SECTION 88

### SIGNS AND SIGNING



## **SUBSECTION 88.00 RAILROAD CROSSING PROTECTIVE SIGNS**

**88.01 DESCRIPTION.** "Railroad Crossing Protective Signs" shall consist of furnishing and installing reflector type railroad crossing signs and advance warning signs in accordance with these requirements and those stipulated in the proposal, and/or shown on the plans, at the locations designated therein and/or as directed.

**88.02 MATERIALS.** All materials shall conform to the requirements for the respective specification sections for the type and kind of materials used and shall meet the requirements stipulated in the proposal and/or shown on the plans.

When reflectorizing material is used, it shall be an approved type of so-called "wide-angle" variety. "Wide-angle" shall mean that effective reflection is obtained at angles not less than 15 degrees each side of a line normal to the face of the sign.

Reflectorized sheeting of the wide-angle variety shall consist of clear glass spheres embedded in a waterproof transparent binder and adhered to a waterproof flexible backing sheet, so as to present a smooth, flat front and silvery appearance. The backing shall consist of synthetic sheet resin or other noncellulosic material.

The sheeting shall be supplied with precoated adhesive on the back and shall be suitable for application to form a durable bond to any well-painted surface. The adhesive shall be activated by means of a solvent or heat. It shall have no staining effect and must be mildew resistant. Any liner which is necessary to keep the adhesive clean or from sticking shall be removable by peeling without the necessity of soaking.

The reflectorized sheeting, stripped of any temporary liner and ready for application, shall have a minimum tensile strength of three pounds per inch of width at 75°F. It shall not be subject to shrinkage, expansion, cracking or brittleness, so as to fail under ordinary handling in shipment or application.

**88.03 CONSTRUCTION METHODS.** Shall conform to the requirements stipulated in the proposal and/or shown on the plans.

**88.04 METHOD OF MEASUREMENT.** Measurement will be by the unit each of the respective types of signs completed and accepted in place.

**88.05 BASIS OF PAYMENT.** Railroad crossing protective signs shall be paid for at the contract unit bid price, which price and payment shall be full compensation for furnishing the signs, reflectorizing material, fittings, posts, concrete, all required supplies, labor, tools, equipment and all incidentals necessary to complete any of the respective type signs in place.

Item Number	Item Description	Unit
8801	Railroad Crossing Protective Signs	Each
8805	Advance Warning Signs	Each



## SECTION 90

### GUARD RAIL AND GUIDE POSTS





**90.01 DESCRIPTION.** "Guard Rail and/or Guide Posts" shall consist of the furnishing and installation of single or multiple wood, metal beam or cable, guard rail and/or guide posts, as stipulated in the proposal, in conformity with the plans and specifications and/or as directed.

**90.02 MATERIALS. (1) Rail. (a) Wood.** Shall be of Douglas Fir, Ponderosa Pine, Northern White Cedar, Western Red Cedar or Larch.

**(b) Cable and Fittings.** Shall conform to the requirements of A.A.S.H.O. Designation M-30. The type and size required will be specified in the proposal and/or shown on the plans.

**(c) Metal Beam and Fittings.** Steel beam guard rail unit, terminal sections and special bolts shall be made of open hearth or electric furnace steel.

The steel shall conform to the following requirements:

	Rail Element	Terminal Sections
Ultimate Tensile Strengths.....	70,000 P.S.I.	60,000 P.S.I.
Yield Point Strength.....	50,000 P.S.I.	33,000 P.S.I.
Elongation in Two Inches.....	12%	12%

Steel beam guard rail parts furnished under this specification shall be interchangeable with similar parts regardless of the source or manufacturer. Bolts, nuts and washers shall be galvanized to conform to A.S.T.M. A-153.

The terminal sections of each run of steel-guard rail shall be finished as shown on the current standard drawing for this item. All metal work shall be pre-fabricated. No punching, cutting or welding shall be done in the field except that holes for special details in exceptional cases may be drilled in the field when approved by the engineer. The edges of the rail shall be rolled or rounded so that no sharp edges are presented. Construction shall be such that all bolt heads will be completely recessed when assembled.

Rail units shall be given one shop coat before shipping. All of the metal parts which are not galvanized shall be thoroughly cleaned and shop painted with one coat of a fast drying rust inhibitive primer. The primer shall be thoroughly dry with a tough and durable surface before the parts are handled or packed for shipment. Formulas used for primers shall have been demonstrated as capable of withstanding at least 200 hours exposure in a weatherometer test conducted in accordance with "Recommended Practice for Light and Water Exposure Apparatus (Carbon Arc Type) for Testing Paint, Varnish, Lacquer, and Related Products" A.S.T.M. D-822-46T with no evidence of cracking, blistering, rusting, checking, peeling, scaling or loss of adhesion.

**(2) Posts and Wood Rail.** (Guard Rail and Guide Posts.)

**(a) Wood.** Shall be of Douglas Fir, Ponderosa Pine, Northern White Cedar, Western Red Cedar, Larch or Lodgepole Pine. Posts shall be straight, sound and free from defects of all kinds and they shall be cut from live trees not less than thirty (30) days in advance of use, but not exceeding one (1) year. Guide posts shall be round or surfaced, as specified. Guard rail posts may be rough-sawed or surfaced at the contractor's option. Shapes and dimensions shall conform to current standard drawings. All bark shall be peeled and the logs trimmed smooth of all knots and projections.

Sawn posts and rails shall be graded, for the grade selected, in accordance with grading rules which conform to the basic provisions of the "American Lumber Standards."

Sawn railing shall be of sufficient length to span two panels, except on curves. Where surfaced lumber is specified on the plans, it shall be surfaced four sides and the dimensions indicated shall be construed to mean the nearest dimension.

**(b) Concrete Posts.** Shall be precast and shall conform to the design and requirements stipulated in the proposal and/or shown on the plans. Concrete shall be Class "D" and shall meet the requirements of Subsection 46.00, "Portland Cement Concrete." Reinforcing steel shall conform to the requirements for Section 47, "Reinforcing Steel."

**(c) Steel posts.** Shall meet the requirements stipulated in the proposal and/or shown on the plans or standard drawings.

**(d) Corrugated Metal.** Corrugated metal guide posts shall conform to the provisions set forth in current standard drawings.

**(3) General. (a) Wood Treatment.** When treatment of posts and/or rail is specified it shall be done in accordance with the requirements of Section 51, "Treated and Untreated Timber," or as stipulated in the proposal and/or shown on the plans. Chamfering and other required framing and boring of bolt holes shall be performed prior to treating the material. Holes made for determination of penetration of preservative shall be plugged with tight fitting treated wood plugs.

**(b) Painting.** When specified, paint shall meet the requirements of Section 54, "Paints for Wood and Metal." Painting shall be performed in conformity with the requirements stipulated in the proposal and/or shown on the plans.

**90.03 CONSTRUCTION METHODS. (1) Posts.** Except for certain types of steel posts which may be set by driving, all posts shall set in holes dug in the ground and firmly tamped to the line and grade established by the engineer. Backfill material shall be placed around the posts, in layers not to exceed three (3) inches loose depth and thoroughly tamped, using water to aid compaction when required, by hand or acceptable machine methods.

Posts and rail shall be so shaped and set that positive and firm contact will result between rail and posts. Detailed requirements for installation and erection of all types of guard rail will be stipulated in the proposal and/or shown on the plans or current standard drawings.

Treated guide posts, when used in conjunction with "Ditch Lining," shall be painted with one coat of black paint (Section 54, Article 54.05, Paragraph (d)) to an elevation even with the top of the headers. The remainder of each post shall be painted with three coats of white paint as specified by Article 54.05. Treated guide posts, when installed for guide purposes only, shall be painted or not painted, as specified. Untreated guide posts shall receive three coats of black paint from the bottom to a line eight inches above ground and three coats of white paint from that line to the top of the post, the paint conforming to the provisions of Article 54.05.

Creosote treated guard rail posts shall not be painted. When the pentachlorophenol treatment is used and the resulting color is not dark brown or black, the posts shall be painted with three coats of black paint conforming to the provisions of Article 54.05.

Untreated guard rail posts shall be painted as prescribed above for guide posts.

(2) **Cable Rail.** Following installation of the fittings in the set posts, the cable shall be threaded through the fittings and tightened sufficiently to take up all the sag between the posts. The exact amount of tightening will depend upon the temperature at the time installation of the cable is made, with allowance made for the effect in change of atmospheric temperature on the length of the cable.

(3) **Wood Rail.** Wood rail shall be installed in conformity with provisions of current standard drawings.

(4) **Metal Beam.** The first field or prime coat shall be applied before erection is started.

The rail unit shall be spliced at each post by lapping in the direction of traffic. The holes in the rail shall be slotted longitudinally to facilitate erection and to permit expansion and contraction. Where the rail is on a curve it shall be shaped before erection. The rails at the splice shall make contact throughout the area of splice.

Bolts through joints and mounting bolts shall be drawn up as tight as possible without being tight enough to prevent the rail elements from sliding past one another longitudinally. Bolts shall be sufficiently long to extend at least one-quarter inch beyond nuts. Except where required for adjustments, bolts shall not extend more than one-half inch beyond the nuts.

After erection, all abrasions on metal parts shall be spot painted with first field coat of paint before final application of aluminum paint. All paints used shall conform to the provisions of Section 54.

**90.04 METHOD OF MEASUREMENT.** Guide posts will be measured by the number of each installed in the completed and accepted work. When "ditch lining" is installed with guide posts, the "ditch lining" shall be measured and paid for under Section 71.

Guard rail will be measured to the nearest lineal foot, along the face of and end to end of rail in the completed and accepted work.

**90.05 BASIS OF PAYMENT.** Guide posts and/or guard rail will be paid for at the contract unit bid price, which price and payment shall be full compensation for furnishing all materials, including posts and rail, fittings, anchors, treatment of the material, paint and painting, water for compaction, backfilling, handling, hauling, erection, installation, all labor, tools, equipment and incidentals necessary to complete the work. Reflectorization of guide posts, when required, shall be included in the bid price for posts.

Item Number	Item Description	Unit
9002	Single Cable Guard Rail— Untreated Wood Posts	Lineal Foot
9004	Single Cable Guard Rail— Treated Wood Posts	Lineal Foot
9006	Single Cable Guard Rail— Concrete Posts	Lineal Foot
9008	Single Cable Guard Rail— Steel Posts	Lineal Foot
9010	Double Cable Guard Rail— Untreated Wood Posts	Lineal Foot
9012	Double Cable Guard Rail— Treated Wood Posts	Lineal Foot
9014	Double Cable Guard Rail— Concrete Posts	Lineal Foot
9016	Double Cable Guard Rail— Steel Posts	Lineal Foot
9030	Single Wood Guard Rail— Untreated Wood Posts	Lineal Foot
9031	Single Wood Guard Rail— Treated Wood Posts	Lineal Foot
9032	Double Wood Guard Rail— Untreated Wood Posts	Lineal Foot

Item Number	Item Description	Unit
9033	Double Wood Guard Rail— Treated Wood Posts	Lineal Foot
9034	Lamin. Wood Guard Rail— Untreated Wood Posts	Lineal Foot
9035	Lamin. Wood Guard Rail— Treated Wood Posts	Lineal Foot
9040	Steel Beam Guard Rail— Untreated Wood Posts	Lineal Foot
9041	Steel Beam Guard Rail— Treated Wood Posts	Lineal Foot
9042	Steel Beam Guard Rail— Concrete Posts	Lineal Foot
9043	Steel Beam Guard Rail— Steel	Lineal Foot
9050	Guide Posts—Untreated Wood— Round	Each
9051	Guide Posts—Untreated Wood— Sawn	Each
9052	Guide Posts—Treated Wood— Round	Each
9053	Guide Posts—Treated Wood— Sawn	Each
9054	Guide Posts— Concrete	Each
9055	Guide Posts— Steel	Each
9056	Guide Posts— Corr. Metal—Type "A"	Each
9057	Guide Posts— Corr. Metal—Type "B"	Each





## SECTION 93

# MARKERS AND MONUMENTS



**93.01 DESCRIPTION.** "Markers and Monuments" shall consist of the furnishing and erection of project markers, station markers, right of way monuments and such other markers as may be specified, conforming to the requirements of the plans and these specifications, at the locations shown on the plans and/or as directed.

**93.02 MATERIAL.** Markers and monuments shall be constructed of the material and in the manner required by the plans, and/or standard drawings. Concrete and reinforcing steel shall conform to the requirements of Subsection 46.00, "Portland Cement Concrete" and Section 47, "Reinforcing Steel" as specified in the pertinent standard drawings.

**93.03 CONSTRUCTION METHODS.** All markers and monuments shall be set in the ground at the exact locations designated by the engineer. They shall be thoroughly tamped into place with care being taken to prevent shifting of position during the course of backfilling and tamping. Reference is here made to the pertinent standard drawing.

Project markers shall be set three (3) feet in the ground opposite the beginning and/or end of projects.

Station markers shall be, unless otherwise directed, set normal to the centerline, at the station shown on the marker, with the face of the marker furthest from the roadway, one (1) foot inside the right of way line.

Right of way monuments, in general, shall be set in such manner that the face of the monument furthest from centerline will coincide with the right of way line.

**93.04 METHOD OF MEASUREMENT.** Markers and monuments will be measured by the number of each type used in the completed and accepted work.

**93.05 BASIS OF PAYMENT.** Markers and monuments will be paid for at the contract unit bid price for the number of each type, complete and accepted in place, which price and payment shall be full compensation for furnishing the markers and/or monuments, erection, all materials, labor, tools, equipment and all incidentals necessary to complete the work.

Item Number	Item Description	Unit
9310	Project Marker	Each
9320	Station Marker	Each
9330	Right of Way Monument	Each



## SECTION 94

### REMOVE AND RESET FACILITIES



**94.01 DESCRIPTION.** "Remove and Reset Facilities" shall consist of removing, from an existing installation, storing, and resetting such facilities and objects as shall be designated by the proposal in accordance with these specifications, the plans and special provisions or as directed by the engineers.

**94.02 MATERIALS.** Any materials that may be necessary in removing and resetting the prescribed facility shall conform, as nearly as practicable, to the materials of which said facility is constructed. If substitution is necessary, the approval of the engineer shall be obtained. If and when the facility being moved and reset is covered by this book of specifications then materials, construction methods and other pertinent provisions of the applicable section shall apply.

**94.03 CONSTRUCTION METHODS.** Facilities designated to be removed and reset shall be removed with utmost care and diligence with all efforts directed toward maintaining the existing condition of the facility. It shall be carefully handled, stored with care if necessary and reset when and where directed by the engineer. The contractor shall be responsible for the condition and care of the facility from the time removal starts until resetting is completed, unless the engineer determines that such a provision is impracticable.

When this specification is inadequate to cover all essentials involved in the work contemplated, a special provision shall be prepared and it shall govern.

**94.04 METHOD OF MEASUREMENT.** Measurement shall be made as indicated by the proposal and the description of the item.

**94.05 BASIS OF PAYMENT.** Payment shall be made in accordance with the bid price in the proposal form which price shall be full payment for all labor, materials, tools, incidentals and other costs involved in the completion of the work.

Item Number	Item Description	Unit
9401	Remove and Reset Wire Fence—Wood Posts	Rod
9402	Remove and Reset Wire Fence—Metal Posts	Rod
9403	Remove and Reset Wire Fence— Metal and Wood Posts	Rod
9404	Remove and Reset Fire Hydrant	Each
9405	Remove and Reset Stock Guard	Each
9406	Remove and Reset Right of Way Monument	Each
9407	Remove and Reset Project Marker	Each
9408	Remove and Reset Station Marker	Each



## SECTION 95

# ADJUSTMENT OF EXISTING STRUCTURES





**95.01 DESCRIPTION.** "Adjustment of Existing Structures" shall consist of the adjustment, to required line and grade, of manholes, catch basins, inlets, water valve boxes and such other utility structures, not privately owned, as may be shown on the plans and/or encountered in the work.

**95.02 MATERIAL.** All material such as concrete, brick and mortar shall meet specifications as noted in the section concerning the particular material involved, or if the material is not covered in these specifications, the material used for adjusting shall be equal, and comparable to that in the existing structure. If extensions for water valve boxes are required, they shall be comparable to the valve boxes found to exist. Close cooperation shall be maintained with the owner of each facility concerning material proposed to be used.

**95.03 METHOD CONSTRUCTION.** All existing manholes, catch basins, inlets, water valve boxes, gas and water shut-offs and all other structures of this kind shall be adjusted to grade by either lowering or raising as required and/or in accordance with the details shown on the plans. Care shall be used in removing portions of the top of the manholes if the cover must be lowered so as to not damage the lower part of the manhole. Before the ring and cover is replaced, the top of the masonry on the manhole must be prepared true to line and grade.

Water valve boxes must be excavated and exposed so as to readily determine whether height adjustment can be made without the use of an extension.

Manholes, catch basins, inlets, water valve boxes and other structures of this kind shall be adjusted to temporary grade before base course material is placed in order to allow the structure to be covered and paving carried over the top. After paving is completed and before seal coat is applied the paving shall be neatly cut to the area required and removed so that the final adjustment can be made to coincide with the grade of the new pavement. Backfilling shall then be placed and compacted around the structure and new paving material of the required thickness placed to complete and evenly fill the area between the cover and the pavement. Manholes may be covered with planking or other substantial material before the pavement is placed. The cast iron ring and cover shall be replaced and set to proper grade after the pavement is in place.

Backfilling around any structures shall be done in accordance with the requirements of Section 75, "Manholes, Catch Basins, Inlets, Etc."

**95.04 METHOD OF MEASUREMENT.** Measurement will be made on the basis of each of the various types of structures required to be adjusted, completed and accepted.

**95.06 BASIS OF PAYMENT.** "Adjustment of Existing Structures" will be paid for at the contract unit bid price, which price and payment shall be full compensation for furnishing all materials, excavation, backfill, labor, tools, equipment and all incidentals necessary to complete the work.

Item Number	Item Description	Unit
9505	Adjustment of Manholes	Each
9510	Adjustment of Catch Basins	Each
9515	Adjustment of Drop Inlets	Each
9520	Adjustment of Valve Boxes	Each
9525	Adjustment of Gas Shut-offs	Each
9530	Adjustment of Water Shut-offs	Each
9535	Adjustment of Water Inspection Plates	Each
9540	Adjustment of Gas Inspection Plates	Each





## SECTION 97

### MISCELLANEOUS ITEMS



This section is to be used for administrative and accounting purposes only. It is not a specification prescribing the use of certain materials nor specifying how work shall be done.

The purpose of this section is to establish item numbers for furnishing of certain materials and/or performing certain work that does not fall within the scope of other sections of this book of specifications.

If and when any of the items listed below are specified in the proposal a supplemental specification shall be prepared, if necessary, which shall set forth any required provisions.

Item Number	Item Description	Unit
9701	Cast Iron Pipe	Lineal Foot
9702	Manhole Cover	Each
9703	Copper Pipe	Lineal Foot
9704	Smooth Steel Pipe	Lineal Foot
9705	Headgate Lumber—Untreated	M.b.m.
9706	Headgate Lumber—Treated	M.b.m.
9707	Galvanized Iron Pipe	Lineal Foot
9708	Black Iron Pipe	Lineal Foot
9709	Bituminous Mixing Plant-Small	Lump Sum





**SECTION 98**  
**PUBLIC UTILITY MOVES**  
**AND**  
**PRELIMINARY COSTS**



This section will be used for administrative and accounting procedures only and its principle purpose is to establish item numbers. Its purpose is to permit and facilitate machine tabulation and accounting of the items listed in the section. Those items will be, in general, public utility facilities that must be moved or relocated, preliminary engineering, right-of-way costs and other items that might fit well into that general category.

The item numbers for various types of costs are listed below. When preparing a project agreement estimate, or similar documents, and two or more like facilities (e.g. power lines) owned by different persons, are involved, a letter suffix will be added.

Thus: 9802 A Move Montana Power Company power line.  
 9802 B Move North Dakota Utility Company power line.

Item Number	Item Description	Unit
9802	Move Power Line Facilities	Lump Sum
9804	Move Telephone Line Facilities	Lump Sum
9806	Move Telegraph Line Facilities	Lump Sum
9808	Move T. V. Line Facilities	Lump Sum
9812	Move Microwave System	Lump Sum
9814	Move Power Sub-station	Lump Sum
9816	Move Telephone Substation	Lump Sum
9820	Move Gas Pipe Line Facilities	Lump Sum
9822	Move Water Pipe Line Facilities	Lump Sum
9824	Move Oil Pipe Line Facilities	Lump Sum
9826	Move Underground Conduit Sys.	Lump Sum
9840	Move Irrigation System Facilities	Lump Sum
9850	Move Railroad Signals	Lump Sum
9852	Move Railroad Crossing	Lump Sum
9890	Preliminary Engineering	Lump Sum
9895	Right-of-Way	Lump Sum



## SECTION 99

# NON-PARTICIPATING STOCKPILES



**99.01 DESCRIPTION.** This section shall concern materials that are stockpiled for use by the department and in which there is no Federal Aid participation in the cost of the material as placed in the stockpile. Some such material may be incorporated in a later contract on a participating basis—e.g., cover material.

**99.02 MATERIAL.** The material shall conform to the provisions of the particular section of these specifications which concerns the material specified in the proposal.

**99.02 CONSTRUCTION AND PRODUCTION METHODS.** These methods shall conform to the provisions of the particular section of these specifications which concerns the material specified in the proposal. Stockpile construction shall conform to the provisions of Section 28.

**99.03 METHOD OF MEASUREMENT.** Measurement shall conform to the methods specified in the section of these specifications which concerns the material specified in the proposal.

Haul of any of the materials shall be in accordance with the applicable provisions of Section 13, "Haul," if such item is in the proposal.

**99.04 BASIS OF PAYMENT.** Payment shall be in accordance with the provisions of the section of these specifications which concern the material specified in the proposal. Haul shall be paid for as specified in Section 13, "Haul," if such item is in the proposal.

The following listed item numbers shall be used. The last two digits coincide with the last two digits in Section 28.

Item Description	Unit	Item No.	Unit	Item No.
Type "A" Top Surfacing— Grading 1	Cubic Yd.	9961	Ton	9971
Type "A" Top Surfacing— Grading 2	Cubic Yd.	9962	Ton	9972
Type "A" Top Surfacing— Grading 3	Cubic Yd.	9963	Ton	9973
Type "A" Top Surfacing— Grading 4	Cubic Yd.	9964	Ton	9974
Type "A" Top Surfacing— Grading 5	Cubic Yd.	9965	Ton	9975
Type "B" Top Surfacing— Grading 1	Cubic Yd.	9967	Ton	9977
Type "B" Top Surfacing— Grading 2	Cubic Yd.	9968	Ton	9978
Type "B" Top Surfacing— Grading 3	Cubic Yd.	9969	Ton	9979
Cover Material— Grading 1	Cubic Yd.	9981	Ton	9991
Cover Material— Grading 2	Cubic Yd.	9982	Ton	9992
Cover Material— Grading 3	Cubic Yd.	9983	Ton	9993
Stone Chips— Grading 1	Cubic Yd.	9984	Ton	9994
Stone Chips— Grading 2	Cubic Yd.	9985	Ton	9995
Stone Chips— Grading 3	Cubic Yd.	9986	Ton	9996







## **ADDENDA**



**STATE OF MONTANA**  
**State Highway Commission**

---

**CONTRACT**

WITH

.....  
Address .....

FOR

CONSTRUCTION OF

.....  
.....County, Montana

.....Project No.....

Date of Execution.....

Work Begun.....

Work Finished.....

Contractor's Number Mailed.....

## CONTRACT

This agreement, made in duplicate this.....day  
 of..... A. D. 19.....,  
 between the State of Montana, by the State Highway Com-  
 mission, hereinafter called the party of the first part, and  
 .....  
 .....  
 of....., a corporation,  
 incorporated under the laws of.....  
 .....  
 its successors and assigns, party of the second part, hereinafter  
 called the Contractor.

(This form when contractor is corporation.)

or

This Agreement, made in duplicate this.....day  
 of..... A. D. 19.....,  
 between the State of Montana, by the State Highway Com-  
 mission, hereinafter called the party of the first part, and  
 .....  
 .....  
 his, her, or their heirs, executors, administrators and assigns  
 party of the second part hereinafter called the Contractor.  
 (This form when contractor is individual or co-partnership)

Witnesseth, That the Contractor, for and in consideration of  
 the payment or payments herein specified and agreed to by  
 the party of the first part, hereby covenants and agrees to  
 furnish, and deliver and pay for all the materials, and to fur-  
 nish all tools, machinery and implements, and to do and  
 perform all the work and labor in the construction or im-  
 provement of a certain highway/bridge.....

.....in .....County,

State of Montana,.....Project No.....  
 according to the dimensions and grades thereof this day agreed  
 upon between the said parties and shown and stated in the  
 plans and specifications hereto annexed, being approximately

..... (.....)  
 miles in length, at the unit prices bid by the said Contractor  
 for the respective estimated quantities, aggregating approxi-  
 mately the sum of.....

.....Dollars (\$.....)

and such other items as are mentioned in.....  
 original proposal, which proposal and prices named, together  
 with the annexed specifications, are made a part of this con-  
 tract and accepted as such, and also the plans of the improve-  
 ment prepared by the State Highway Commission, are also  
 agreed by each party as being a part hereof; the said im-  
 provement being situated as follows:

.....  
 .....  
 .....  
 .....  
 It is understood and agreed by and between the parties  
 hereto that the work included in this contract is to be per-  
 formed under and in accordance with the Standard Specifica-  
 tions for Road and Bridge Construction of the State Highway  
 Commission of the State of Montana as set out by the latest  
 official edition thereof, which Standard Specifications are  
 hereby made a part of this contract by this reference thereto.

It is understood by and between the parties hereto that  
 the work included in this contract is to be done under the di-  
 rection of the Engineer of the State Highway Commission  
 and that his decision as to the construction and meaning of  
 the drawings and specifications shall be final. It is also under-  
 stood and agreed by and between the parties hereto that such  
 additional drawings and explanations as may be necessary to  
 detail and illustrate the work to be done are to be furnished  
 by said Engineer, and the parties hereto agree to conform to  
 and abide by the same so far as they may be consistent with  
 the purpose and intent of the original drawings and specifica-  
 tions referred to herein. It is further understood that the  
 work shall be subject to inspection at all times and approval  
 by the Department of Commerce, or its agents, and shall be  
 performed in accordance with the laws of the State of Mon-



tana and the rules and regulations of the Secretary of Agriculture made pursuant to the certain act of Congress approved July 11, 1916, (39 U. S. Statutes at Large, 335) entitled "An act to provide that the United States shall aid the state in the construction of rural post roads, and for other purposes," and all Acts of Congress supplementary and amendatory thereto.

The Contractor further covenants and agrees that all of said work and labor shall be done and performed in the best and most workmanlike manner and that all and every of said materials and labor shall be in strict and entire conformity, in every respect, with the said specifications and plans and shall be subject to the inspection and approval of the Engineer of the State Highway Commission, or his duly authorized assistant, and, in case any of said materials or labor shall be rejected by the said Engineer, or his assistant, as defective or unsuitable, then the said materials shall be removed and replaced with other approved materials and the said labor shall be done anew, to the satisfaction and approval of the said Engineer, or his assistant, at the cost and expense of the Contractor.

The Contractor further covenants and agrees that he will well and truly pay all laborers, mechanics, subcontractors and material men who perform work or furnish material under this contract, and all persons who shall supply him and/or the subcontractors with provisions, provender and supplies for the carrying on of the work.

The Contractor further covenants and agrees that he will except as herein provided, begin the actual performance of the work required and contemplated under this agreement within ten days after the date of the execution of this contract and that all and every of the said materials shall be furnished and delivered and all and every of the said labor shall be done and performed in every respect to the satisfaction and approval of the Engineer aforesaid on or before

It is expressly understood and agreed that in case of the failure on the part of the Contractor, for any reason, except with the written consent of the State Highway Commission, to complete the furnishing and delivery of the said material and the doing and performance of said work on or before

....., the party of the first part shall have the right to deduct from any moneys due the Contractor, or if no moneys shall be due, the party of the first part shall have the right to recover the amount of

..... Dollars (\$.....) per day, as fixed, agreed and liquidated damages, for each and every calendar day elapsing between the date above

stipulated for completion and the actual date of completion and final acceptance; this in accordance with the paragraph of the Standard Specifications hereto annexed which refers to "Failure to Complete the Work on Time." Provided, however, that upon receipt of written notice from the Contractor of the existence of causes over which said contractor has no control and which must delay the completion of the said work, the State Highway Commission, may, at its discretion, extend the period hereinbefore specified for the completion of the said work, and in such case the contractor shall become liable for said liquidated damages for delays commencing from the date on which said extended period shall expire.

The Contractor further covenants and agrees that he will, without further expense to the party of the first part, remove all surplus soil and rubbish from off the said land and leave the said road and parts of the land or field adjoining it affected by such work, in the proper state, order and condition.

It is expressly understood and agreed that if the Contractor fails to comply with any of the requirements of the plans or specifications, or shall discontinue the prosecution of the work, or if the Contractor shall become insolvent or bankrupt, or commit any act of bankruptcy or insolvency, or allow any final judgment to stand against him unsatisfied for a period of six (6) days, or shall make an assignment for the benefits of creditors, or from any other cause whatsoever shall not carry on the work in an acceptable manner, the Engineer shall give notice in writing to the contractor and his surety of such delay, neglect or default, specifying the same, and if the contractor within a period of three (3) days after such notice shall not proceed in accordance therewith, then the Commission, shall, upon written certificate from the Engineer of the fact of such delay, neglect or default and the Contractor's failure to comply with such notice, have full power and authority, without violating the contract, to take the prosecution of the work out of the hands of said Contractor, to appropriate or use any or all materials and equipment on the ground as may be suitable and acceptable and may enter into an agreement with any other person or persons for the completion of said contract according to the terms and provisions thereof, or use such other methods as it may deem expedient for the completion of said contract in the specified manner. All costs and charges incurred by the Commission, together with the costs of completing the work under contract, shall be deducted from any moneys due or which may become due said Contractor. In case the expense so incurred by the Commission shall be less than the sum which would have been payable under the contract, if it had been completed by said Contractor, then the said Contractor shall be entitled to receive the difference; and in case such expense shall exceed the sum which would have been payable under the contract, then the Contractor and the surety shall be liable and shall pay to the state the amount of said excess.

It is expressly understood and agreed that no claim for extra work or materials, not specifically herein provided, done or furnished by the Contractor, will be allowed by the State Highway Commission, nor shall the Contractor do any work or furnish any materials not covered by these specifications and contract unless such work is ordered in writing by the Engineer. In no event shall the Contractor incur any liability by reason of any verbal directions or instructions that he may be given by the said Engineer, or his authorized assistant; nor will the said party of the first part be liable for any extra materials furnished or used, or for any extra work or labor done, unless said materials, work or labor are required by said Contractor on written order furnished by the said Engineer. Any such extra work or materials which may be done or furnished by the Contractor without such written order first being given shall be at said Contractor's own risk, cost and expense, and he hereby covenants and agrees that without such written order he shall make no claim for compensation for work or materials so done or furnished.

The Contractor further covenants and agrees that during the progress of the work to be performed under the provisions of this contract, he will in every respect comply with the provisions of the Workmen's Compensation Act, being Chapter 96 of the Session Laws of the 14th Legislative Assembly of the State of Montana, and with all statutory provisions supplementary or amendatory thereto.

In case any claim or dispute arises between the parties hereto respecting any matter pertaining to this agreement, or any part thereof, said claim or dispute shall be referred to the State Highway Commission by the Contractor in writing, and a request for hearing within a period of sixty (60) days after the claim or dispute has arisen, and, upon request, the Commission shall afford the Contractor an opportunity for a hearing as early as practicable within not to exceed thirty (30) days after receipt of such request, in the County of Lewis and Clark, State of Montana, unless the Commission and the Contractor agree that such hearing may be held in some other county. Upon such hearing, the Commission shall be the authority to hear said claim or dispute, and render a decision and appropriate order.

The Contractor shall have the right to appeal to any District Court of the State of Montana within one year after a final decision has been rendered pursuant to the settlement procedure hereinabove contained.

It is expressly understood and agreed that the Contractor will notify the State Highway Commission in writing of the date upon which his work will be completed and ready for a final inspection; that upon receipt of such notice from the Contractor, the Engineer will arrange for a final inspection of the work, such inspection to be had within fifteen days of the date specified in such notice from the Contractor; that final payment for the work will be made within ninety days of the date of the final acceptance of the project by the Engineer.

The Contractor further agrees that he will save and keep harmless the said State of Montana against and from all losses to it from any cause whatever, including patent, trade mark and copyright infringements in the manner of constructing such section of roadway.

The Contractor hereby further agrees to receive the following prices as full compensation for furnishing all the materials and labor which may be required in the prosecution and completion of the whole of the work to be done under this contract or agreement, and in all respects to complete said contract to the satisfaction of the State Highway Commission; it being understood and agreed by and between the parties hereto that ninety per cent (90%) of the amount due for the completion of work during any working month exclusive of "extra work" and "extra materials," when and only when such amount is in excess of Five Hundred Dollars (\$500.00) shall be paid to the contractor by the party of the first part within thirty days after the expiration of that working month, and all unpaid balances due on the final estimate shall be paid similarly to the Contractor within ninety days after the final acceptance of the contract, as provided in the second paragraph supra; the estimate in all cases of the work completed during any working month as well as the final estimate, to be prepared by the Engineer of the State Highway Commission or his authorized assistant.

(Here refer to schedule of bid prices submitted by Contractor with his Proposal Form, which schedule and Proposal Form are inserted and, by agreement of both parties, are made a part of the Contract.)

It is expressly understood and agreed by and between the parties hereto that as a condition precedent to the complete execution of this contract the Contractor will furnish a good

and sufficient surety bond in the amount of.....

.....Dollars (\$.....)

to be conditioned upon the faithful performance of the covenants and agreements as herein set forth by him to be performed, subject to the approval of the State Highway Commission and the Attorney General of the State of Montana.

(Incorporated firms sign below.)

In witness whereof, the Chairman of the State Highway Commission, by authority in him vested, has hereunto subscribed his name on behalf of the State of Montana and affixed the seal of the State Highway Commission, hereto, and

the said.....

has hereto attached its corporate seal duly attested by the signature of its duly authorized officers, the day and year above written.



STATE OF MONTANA  
STATE HIGHWAY COMMISSION

By .....  
Chairman.

.....  
Contractor.

By .....  
President.

Attest:  
.....  
(SEAL) Secretary.

Attest:  
.....  
(SEAL) Secretary.

(Individual contractors or copartnership firms sign below.)

In witness whereof, the Chairman of the State Highway Commission, by authority in him vested, has hereunto subscribed his name on behalf of the State of Montana and affixed the seal of the State Highway Commission, hereto, and

the said.....

hereunto set.....hand.....and seal....., the day and year first above written.

STATE OF MONTANA  
STATE HIGHWAY COMMISSION

By .....  
Chairman.

..... (SEAL)

..... Contractor.  
..... (SEAL)

..... (SEAL)

..... (SEAL)

..... (SEAL)

..... (SEAL)

Attest:  
.....  
(SEAL) Secretary.

Witnesses:  
.....  
.....



CONTRACT BOND

KNOW ALL MEN BY THESE PRESENTS, That we,.....

.....  
.....  
.....

hereinafter called the "Principal" and.....

.....  
.....

a corporation licensed under the laws of the State of Montana,  
hereafter called the "Surety" are held and firmly bound unto

the State of Montana in the full and just sum of.....

.....  
.....Dollars (\$.....)

lawful money of the United States of America, to be paid to  
the State of Montana, or its assigns, to which payment well  
and truly to be made and done, we bind ourselves, our heirs,  
executors, administrators and successors, jointly and severally,  
firmly by these presents.

Sealed with our respective seals and dated this.....

.....day of....., 19.....

WHEREAS, The above bounden "Principal" has entered  
into a contract with the State of Montana, by the State High-  
way Commission, through its Chairman bearing even date  
herewith, for the construction or improvement of a certain

section of highway/bridge...../.....

in.....County, State of Montana

.....Project No.....

being approximately..... (.....)

miles in length for approximately the sum of.....

.....Dollars (\$.....)

the said highway/bridge...../.....being

situated as follows:.....

.....

.....

.....

and,

WHEREAS, It was one of the conditions of the award of the State Highway Commission, acting for and on behalf of the State of Montana, pursuant to which said contract was entered into, that these presents should be executed;

NOW, THEREFORE, The condition of this obligation is such that if the above bonded "Principal" as Contractor shall in all respects faithfully perform all of the provisions of said contract, and his, their or its obligations thereunder including the specifications therein referred to and made part thereof and such alterations as may be made in said specifications as therein provided for, and shall well and truly; and in a manner satisfactory to the State Highway Commission, complete the work contracted for, and shall save harmless the State of Montana, from any expense incurred through the failure of said Contractor to complete the work as specified, or from any damages growing out of the carelessness of said Contractor or his, their or its servants, or from any liability for payment of wages due or material furnished said Contractor, and shall well and truly pay all laborers, mechanics, subcontractors and material men who perform work or furnish material under said contract, and all persons who shall supply him or the subcontractor with provisions, provender and supplies for the carrying on of the work, and also shall save and keep harmless the said State of Montana against and from all losses to it from any cause whatever, including patent, trademark and copyright infringements, in the manner of constructing said section of work, then this obligation to be void or otherwise to be and remain in full force and virtue.

Witnesses:

.....

.....

Attest:

.....

Ass't. Secretary.

(SEAL)

.....

.....

.....

.....

.....

.....

.....

.....

(SEAL)

(SEAL)

(SEAL)

(SEAL)

(SEAL)

(SEAL)

(SEAL)

Surety Company.

By .....

Attorney-in-Fact.

Approved to form and legality.

.....

Attorney General.

By .....

Assistant.

AUDITOR  
APPROVAL OF STATE

.....

## Acts Relating To Liens

An Act Requiring That Any Board, Council Commission, Trustees or Body Acting for the State of Any County or Municipality or any Public Body, Who Shall Contract with Any Person or Corporation to do Any Work for the State, County, Municipality or Other Public Body, to Require a Good and Sufficient Bond Therefore, and Providing the Terms, Conditions and Provisions of Said Bond, and Prescribing the Liability of the State or Any County or Municipality or Public Body for Failure to Take Such Bond and Repealing All Acts or Parts of Acts in Conflict Herewith.

BE IT ENACTED BY THE LEGISLATIVE ASSEMBLY OF  
THE STATE OF MONTANA:

Section 1. Whenever any board, council, commission, trustees or body acting for the state, or any county, municipality or any public body, shall contract with any person or corporation to do any work for the state, county, or municipality or other public body, city, town or district, such board, council, commission, trustees or body shall require the corporation, person or persons with whom such contract is made, to make, execute and deliver to such board, council, commission, trustees or body, a good and sufficient bond with two or more sureties, or with a surety company as surety, conditioned that such corporation, person or persons shall faithfully perform all of the provisions of such contract, and pay all laborers, mechanics, subcontractors and material men, and all persons who shall supply such corporation, person or persons, or subcontractors with provisions, provender, material, or supplies for the carrying on of such work, a copy of such bond shall be filed with the county clerk and recorder of the county where such work is performed or improvement made, or if to be performed in more than one county, then with the county clerk of either county, except in cases of cities and towns, in which case such bond shall be filed with the city or town clerk thereof; and any corporation, person or persons performing such services, or furnishing such provender, provisions, supplies, or material to any subcontractor shall have the same right under the provisions of such bond as if such work, services, provender, provisions, supplies or material, was furnished to the original contractor; provided, however, that the provisions of this Act shall not apply to any money loaned or advanced to any such contractor, subcontractor or other person in the performance of any such work.

Section 2. Every person, firm or corporation furnishing provender, provisions, materials or supplies to be used in the construction, performance, carrying on, prosecution or doing of any work for the state, or any county, city, town, district, municipality or other public body, shall not later than seven (7) days after the date of the first delivery of such provender, material, supplies or provisions to any subcontractor or agent of any person, firm or corporation having a subcontract for the construction, performance, carrying on, prosecution or doing of such work, deliver or send by registered mail to the contractor a notice in writing stating in substance and effect that such person, firm or corporation has commenced to deliver provender, provisions, materials or supplies for use thereon, with the name of the subcontractor or agent ordering or to whom the same is furnished, and that such contractor and his bond will be held for the same, and no suit or action shall be maintained in any court against the contractor or his bond to recover for such provender, provisions, material or supplies, or any part thereof, unless the provisions of this Act have been complied with.

Section 3. If any board, council, commission, trustee or body acting for the state, or any board of county commissioners or any mayor and common council of any incorporated city or town, or tribunal transacting the business of any such municipal corporation, shall fail to take such bond as herein required, the state or such county, incorporated city or town, or other municipal corporation shall be liable to the persons mentioned in Section 1 to the full extent and for the full amount of all such debts so contracted by any such subcontractor as well as such contractor.

Section 4. (As amended by Chapter 96 of the 27th Legislative Assembly Session Laws.) The bond mentioned in Section 1 shall be in an amount equal to the full contract price agreed to be paid for such work or improvement, and shall be to the State of Montana, except in cases of cities and towns, in which case such municipality may, by general ordinance, fix and determine the amount of such bond, and to whom such bond shall run; provided, that the same shall not be for a less amount than twenty-five per centum (25%) of the contract price of any such improvement, and may designate that the same shall be payable to such city or town and not to the State of Montana. All such persons mentioned in said Section 1 shall have a right of action in his or her or their own name or names, on any bond furnished under the terms of this act for work done by such laborers or mechanics and for provender, materials, supplies, provisions or goods supplied and furnished in the prosecution of such work or the making of such improvements; provided, that such persons shall not have any right of action on such bond for any sum whatever, unless within thirty (30) days from and after the completion of the contract with an acceptance of the work by the affirmative action of the board, council, commission, trustees, officer or body acting for the state, county or municipality or other public body, city, town or district, the laborer, mechanic or subcontractor, or material man or person claiming to have supplied provender, materials, provisions or goods for the prosecution of such work, or the making of such improvement, shall present to and file with such board, council, commission, trustees or body acting for the state, county or municipality or other public body, city, town or district, a notice in writing in substance as follows:

“TO (here insert the name of the state, county, or municipality or other public body, city, town or district):.....  
.....



NOTICE IS HEREBY GIVEN that the undersigned (here inset the name of the laborer, mechanic or subcontractor, or materialman, or person claiming to have furnished such labor, materials or provisions for or upon such contract or work)

.....

.....

has a claim in the sum of ..... Dollars

(.....) against the bond taken from

.....

(here insert the name of the principal and surety or sureties

upon such bond) for the work of.....

(here insert a brief mention or description of the work concerning which said bond was taken).

(Here to be signed).....

Such notice shall be signed by the person or corporation making the claim or giving the notice, and said notice, after being presented and filed, shall be a public record open to inspection by any person, and in any suit or action brought against such surety or sureties by any such person or corporation to recover for any of the items hereinbefore specified, the prevailing party shall be entitled to recover in addition to all other costs, attorneys' fees in such sum as the court shall adjudge reasonable; provided, however, that no attorneys' fees shall be allowed in any suit or action brought or instituted before the expiration of thirty (30) days following the date of filing of the notice hereinbefore mentioned; and provided further, that any city or town may impose any other or further conditions and obligations in such bond as may be deemed necessary for its proper protection in the fulfillment of the terms of the contract secured thereby, and not in conflict herewith."

Section 5. All acts and parts of acts in conflict herewith are hereby repealed.

#### SUPREME COURT DECISIONS.

Kirkpatrick Bros. vs. A. R. Douglas, et al., 104 Mont.  
212 and/or 65 Pac. (2nd) 1169.

H. Earl Clack Company vs. Thomas Staunton, 104 Mont.  
375 and/or 72 Pac. (2nd) 1022.



# INDEX

Note: For Definition of Many Terms, See Section 1.

	Section	Page
Abutting Joints, Structural Steel.....	42	260
Acceptance and Final Payment.....	9	67
Adjustment of Miscellaneous Facilities .....	95	464
Agreement, Supplemental .....	4	22
Aggregate Admixture .....	22	134
Aggregate Backfill .....	62	380
Aggregates, Concrete Coarse.....	46	294
Aggregates, Concrete, Fine.....	46	293
Aggregate Stockpiles .....	28	164
Arch Centering .....	41	248
Arch Culverts .....	64, 66	388, 396
Asphalt, Liquid (See Bituminous Material)		
Asphalt Plant .....	53	350
Award of Contract .....	3	20
Backfill, Aggregate (Gravel).....	62	380
Barricades, Danger, Warning and Detour Signs .....	7	42
Base Course Surfacing (See Surfacing Course)		
Bearing and Anchorage.....	42	264
Bearing Plates, Bronze.....	49	326
Bearing Plates, Cast Steel.....	50	328
Bidder, Competency of.....	2	17
Bidder, Disqualification of.....	2	16
Bids, Consideration of.....	3	20
Bids, Conditional .....	2	16
Binder or Filler.....	26	156
Bituminous Material Asphalt Cement .....	30	168
Bituminous Material Rapid Curing Cut Back Asphalt..	30	168
Bituminous Material Medium Curing Cut Back Asphalt	30	168
Bituminous Material Slow Curing Cut Back Asphalt.....	30	168
Bituminous Material Emulsified Asphalt .....	30	168
Bituminous Material, Penetration Asphalt and Rubberized.....	30	168

	Section	Page
Bituminous Material, Rubberized		
Rapid Curing Cut Back Asphalt....	30	168
Bituminous Surface Treatment.....	33	186
Bituminous Surfacing		
(See Surfacing Course)		
Bond, Approval of.....	3	20
Bond, Contract Bond required.....	3	20
Bond, Form of.....		484
Borrow (excavation) .....	11	81
Box Culverts, Concrete.....	44	278
Bridge, Concrete .....	41	247
Bridge, Steel .....	42	252
Cable, Wire Guard Rail.....	90	454
Catch Basins .....	75	430
Cattle Guard (See Stock Guard)		
Cement, Portland .....	46	286
Cement, Air-entraining .....	46	286
Chain Link Fence (See Fence)		
Character of Workmen and		
Equipment .....	8	52
Claims, Responsibility for Damages....	7	43
Clearing .....	10	70
Clearing and Grubbing.....	10	73
Cofferdams .....	45	281
Compaction, Embankment .....	11	86, 87
Compaction, Surfacing Courses.....	14	98
Concrete, Air-entraining .....	46	286, 293
Concrete, Class "F".....	46	315
Concrete, Classification .....	46	286
Concrete, Cold Weather.....	46	308
Concrete, Composition and		
Proportioning .....	46	287
Concrete, Consistency .....	46	299
Concrete, Curing .....	46	309
Concrete, Depositing Under Water....	46	306
Concrete, Drainage and Weep Holes..	46	314
Concrete, Expansion Joints.....	46	306
Concrete, Falsework .....	46	296
Concrete, Finishing .....	46	312
Concrete, Forming Joints .....	46	306
Concrete, Mixing .....	46	299
Concrete, Pipes, Conduits and Ducts..	46	314
Concrete, Placing .....	46	302

	Section	Page
Concrete, Ready Mixed.....	46	300
Concrete, Removal of Forms and Falsework .....	46	311
Concrete, Tests and Strength Requirements .....	46	287
Concrete, Various Classes.....	46	286
Concrete Bridges .....	41	248
Concrete Pavement .....	39	222
Concrete Piling .....	52	336
Construction Stakes .....	5	29
Contract, Annulment of.....	8	60
Contract, Approval of.....	3	20
Contract, Assigning or Subletting.....	8	52
Contract, Award of.....	3	20
Contract, Completion Date, Extension of .....	8	55
Contract, Execution of.....	3	20
Contract, Failure to Complete on Time .....	8	59
Contract, Failure to Execute.....	3	20
Contract, Form of.....		476
Contract, Completion, Calendar Date	8	54
Contract, Completion, Calendar Day	8	55
Contract, Termination of.....	8	61
Contract Bond .....		484
Contract Bond, Required.....	3	20
Contractor, Cooperation by.....	5	29
Contractor, Responsibility for Work..	7	44
Contractor, Responsibility for Damage .....	7	43
Control of Material.....	6	32
Control of Work.....	5	27
Corrugated Metal Pipes (See Pipe)		
Cribs and Shoring.....	45	281
Culverts, Concrete Box.....	44	278
Culverts, Arch.....	69	408
Culverts, Corrugated Metal.....	63, 64	382, 388
(See Pipes, Structural Plate, Underdrains)		
Culverts, Remove and Relay.....	61	376
Culverts, Reinforced Concrete.....	68, 69	402, 408
Curbs .....	46, 74	313, 424
Curb and Gutter.....	74	424



	Section	Page
Damage Claims, Responsibility for....	7	43
Damages, Liquidated .....	8	60
Defective Work .....	5	30
Defective Materials .....	6	37
Definition and Terms.....	1	3
Detours, Construction and Maintenance of .....	4	23
Deviations, Allowable .....	5	28
Disposal of Removed Bridge Material .....	40	244
Disposal of Surplus Material.....	11	83
Drains (See Underdrains)		
Drawings, Working and Plans.....	5	28
Embankment .....	11	83
Embankment at Bridge Ends and Culverts .....	11	85
Embankment, Handlaid rock.....	59	366
Emulsified Asphalt (See Bituminous Materials)		
Engineer, Authority of.....	5	28
Equipment, Character of.....	8	52
Equipment, Use .....	16	106
Equipment and Plant.....	5	31
Estimates, Interpretation of.....	2	14
Estimates, Progress .....	9	66
Estimates, Final .....	9	67
Exemption from Federal Tax.....	7	49
Existing Surface Preparation.....	16	107
Existing Surface Removal.....	16	107
Excavation for Retaining Walls.....	11	82
Excavation for Rip Rap.....	11	82
Excavation for Rubble Masonry.....	11	82
Excavation, Culvert .....	11	82
Excavation, Ditch .....	11	78
Excavation, Rock .....	11	78
Excavation, Rock Disposal of.....	11	79
Excavation, Special Borrow.....	11	82
Excavation, Structure .....	45	280
Excavation, Trench .....	11	78
Excavation, Unclassified (and Borrow) .....	11	78
Expansion Joints .....	39, 46	231, 306
Expansion Joint Filler.....	39	223

	Section	Page
Explosives, Use of.....	7	42
Ex-Service Men, Employment of.....	7	46
Extra Work .....	4	23
Failure to Complete Work on Time....	8	59
Federal Participation .....	7	41
Fence, Chain Link.....	79	443
Fence, Wire .....	79	432
Fence, Removal of.....	40	246
Fence, Remove and Reset.....	94	462
Fence, Stock Guard.....	79	441
Fertilizer .....	17	118
Filler or Binder.....	26	156
Fills (See Embankment)		
Finishing Earth Graded Roads.....	11	79
Fires, Responsibility for.....	7	40
Floor Drain .....	41	248
Flume Metal and Wood.....	71	414
Forms and Falsework, Removal of....	39, 42, 46	224, 266, 312
Foundation Course .....	39	223
Foundation Materials .....	45	280
Fuel Tax Returns.....	7	48
Galvanized Iron, Structures.....	53	350
Gravel (See Aggregates)		
Gravel Pits, Clean Up.....	4	25
Grubbing .....	10	72
Grubbing and Clearing.....	10	73
Guard Fence .....	53	350
Guard Rail, Steel Beam.....	90	454
Guard Rail, Wire Cable.....	90	454
Guard Rail, Wood.....	90	454
Guard Rail, Posts .....	90	454
Guaranty, Material .....	2	17
Guaranty, Proposal .....	2	15
Guaranty, Return of .....	3	20
Guide Posts, Concrete.....	90	455
Guide Posts, Steel.....	90	455
Guide Posts, Wood.....	90	455
Gutter .....	74	424
Hand-laid Rock Embankment.....	59	366
Hand-laid Rock Embankment, Excavation for .....	11	82
Hardware, Galvanized .....	43, 79	272, 432, 443

	Section	Page
Haul, Various Materials.....	13	92
Headgates, Concrete .....	74	427
Headwalls, Concrete .....	74	427
Highway, Opening to Traffic.....	7	44
Inlets .....	75	430
Inspection (of work and materials)...	5	30
Inspection, Excavation for Structures	45	282
Inspection, Final .....	5	31
Inspection, Mill and Shop, Steel.....	47	318
Inspection, Plant, Materials.....	6	36
Inspector, Authority and Duty of.....	5	30
Insurance .....	7	43, 46
Irrigation Water, Maintenance of.....	7	49
Item Numbers (See Page 1 and end of each section or subsection)		
Joints, Expansion .....	39, 46	231, 306
Laboratory, Helena .....	1	7
Laboratory, Field .....	20	123
Laws to be Observed.....	7	40
Legal Relations and Responsibility to Public.....	7	39
Legal Right, No Waiver of.....	7	45
Licenses and Permits.....	7	41
Limitation of Operations.....	8	54
Lining, Ditch. Metal and Wood.....	71	414
Liquidated Damages .....	7, 8	48, 60
Load Limit, Restrictions.....	7	49
Maintenance of Traffic.....	16	110
Manholes .....	75	430
Markers, Project .....	93	460
Markers, Station .....	93	460
Masonry, Cement Rubble.....	58	362
Masonry, Dry Rubble.....	58	362
Masonry, Excavation for.....	11	82
Material, Control of.....	6	32
Material, Defective .....	6	37
Material, Found on Work, Rights in use of.....	4	25
Material, Marking and Shipping.....	42	263
Material, Mill and Shop Inspection of	42	262

	Section	Page
Material, Source of Supply and Quality .....	6	34
Material, Storage of.....	6	37
Material, Surplus, Disposal of.....	11	83
Material Guaranty .....	2	17
Measurement (See end of each Section or Subsection)		
Measurement and Payment.....	9	63
Monuments, Preservation and Restoration .....	7	43
Monuments, Right of Way.....	93	460
Mulching .....	17	119
Nuts, Driving and Pilot.....	42	262
Obliteration at Old Roadway.....	16	114
Obstructions and Structures, Removal and Disposal.....	4	24
Oil, Road (See Bituminous Materials)		
Omitted Items .....	9	66
Opening of Section of Highway to Traffic .....	7	44
Operations, Limitations of.....	8	54
Overhaul, various materials.....	12	90
Paint, Materials and Specifications..	54	352
Painting, Steel, Shop.....	42	268
Painting, Steel, Field.....	42	267
Painting, Wood .....	43, 90	275, 456
Participation, Federal .....	7	41
Patented Devices, Materials and Processes .....	7	41
Pavement, Portland Cement Concrete .....	39	222
Payments (See end of each Section or, Subsection)		
Payment and Measurement.....	9	63
Payment and Acceptance, Final.....	9	67
Payment for Altered Quantities.....	9	64
Payments, Partial .....	9	66
Payments, Scope of.....	9	64
Permits and Licenses.....	7	41
Pile Shoes .....	52	339
Piling, Concrete .....	52	339
Piling, Driving .....	52	340
Piling, Steel .....	52	340

	Section	Page
Piling, Timber .....	52	336
Piles, Loading Tests.....	52	343
Piles, Precast Concrete.....	52	339
Piles, Splicing of.....	52	342
Piles, Steel .....	52	340
Piles, Test .....	52	343
Pipe, Concrete .....	68, 69, 70	402, 408, 410
Pipe, Corrugated Metal.....	60, 63, 64	368, 382, 388
Pipe, Reinforced Concrete.....	69	408
Pipe, Structural Plate.....	65, 66	392, 396
Pipe, Syphon .....	63	382
Pipe, Elliptical .....	63, 65	382, 392
Pipe, Bituminous Treated.....	72	418
Pipe, Removal and Relay.....	61	376
Pipe, Perforated .....	63	382
Pipe, Specifications for Materials (See each Section)		
Pipe, Transite .....	53	350
Plans, Conformity with.....	5	28
Plans, Examination of.....	2	14
Plans, Intent of.....	4	22
Plans and Working Drawings.....	5	28
Plant and Equipment.....	5	31
Plant Inspection of Materials.....	6	36
Plant Mix Surface Course.....	35	202
Posts, Guard Rail and Guide.....	90	454
Posts, Fence, Wire.....	79	432
Posts, Fence, Chain Link.....	79	443
Precast Prestressed Concrete Beam....	41	248
Prime Coat, Bituminous.....	32	182
Project Markers .....	93	460
Property, Preservation and Restoration .....	7	43
Proposal, Contents of.....	2	14
Proposal, Delivery of.....	2	15
Proposal, Preparation .....	2	14
Proposal, Rejection .....	2	15
Proposal, Withdrawal of.....	2	16
Proposal, Guaranty .....	2	15
Proposal, Guaranty, Return of.....	3	20
Prosecution and Progress.....	8	51
Protection of Roadway Structures and Traffic .....	33	191
Public Convenience and Safety.....	7	42



	Section	Page
Quantities, Altered .....	9	64
Quantities, Increased or Decreased.....	4	22
Quantities, Measurement of.....	9	64
Railing, Various Types .....	53	348
Reinforced Concrete Pipe.....	68	402
Reinforcing Steel .....	47	318
Relaying Pipe Culverts.....	61	376
Removal of Miscellaneous Facilities..	40	246
Removal of Defective Work.....	5	30
Removal of Existing Structures.....	40	244
Removal of Pipe Culverts.....	61	376
Remove and Reset Miscellaneous Facilities .....	94	462
Retaining Walls .....	44	278
Revision of Bridge.....	41	248
Right of Way .....	7	47
Riprap, Concrete Slab.....	57	359
Riprap, Grouted .....	57	357
Riprap, Hand Laid.....	57	356
Riprap, Random .....	57	356
Riprap, Sack Concrete.....	57	358
Rivets .....	42	254
Rivets, Weight of.....	48	324
Rockers, Cast Steel.....	50	328
Rollers, Types and Description.....	14	96
Rolling Embankment .....	11, 14	84, 97
Rolling Surface Courses.....	14	98
Road Mix Surface Course.....	34	194
Roadside Clean-up .....	10	74
Samples and Tests .....	6	36
Sand Backfill .....	62	380
Sand, Fine Aggregate—Concrete.....	46	293
Sand, Coarse Aggregate—Concrete....	46	294
Sand, Mortar .....	57	357
Sanitary Provisions .....	7	42
Seal Coat, Bituminous.....	36	216
Seeding .....	17	117
Sewer Tile .....	70	410
Shoring and Cribbs.....	45	281
Sidewalks .....	46, 74	313, 426
Signs and Signing .....	88	452
Signs, Warning and Detour.....	7	42

	Section	Page
Smoothness, Surface, Base Course.....	20	126
Smoothness, Surface, Plant Mix.....	35	213
Smoothness, Surface, Soil Cement.....	22	139
Soil Cement .....	22	135
Source of Supply and Quality.....	6	34
Special Provisions, coordination with Plans and Specifications.....	5	28
Special Work .....	4	22
Specifications, Intent of.....	4	22
Specifications, Coordination with Plans and Special Provisions.....	5	28
Stakes, Construction .....	5	29
Station Markers .....	93	460
Steel Bridges .....	42	252
Steel, Reinforcing, Bending Requirements .....	47	318
Steel, Reinforcing, Splicing.....	47	319
Steel, Reinforcing, Weights of Bars....	47	320
Steel, Structural, Assembling, Shop..	42	254
Steel, Structural, Assembling, Field	42	265
Steel, Structural, Bearing and Anchorage .....	42	264
Steel, Structural, Bearing Surfaces..	42	260
Steel, Structural, Bolts.....	42	255
Steel, Structural, Drilled Holes.....	42	254
Steel, Structural, Erection .....	42	263
Steel, Structural, Eyebars.....	42	261
Steel, Structural, Fabrication.....	42	252
Steel, Structural, Marking and Shipping .....	42	263
Steel, Structural, Materials.....	42	252
Steel, Structural, Mill and Shop Inspection .....	48	322
Steel, Structural, Painting.....	42	267
Steel, Structural, Pilot and Driving Nuts .....	42	262
Steel, Structural, Pins.....	42	262
Steel, Structural, Punching.....	42	253
Steel, Structural, Reaming.....	42	253
Steel, Structural, Rivets and Riveting .....	42	254, 259
Steel, Structural, Shop Drawings.....	42	252
Steel, Structural, Straightening.....	42	265
Steel, Structural, Storage.....	42	263

	Section	Page
Steel, Structural, Web Plates.....	42	261
Steel, Structural, Workmanship and Finish .....	42	252
Stock Guard .....	79	441
Stocked Piled Aggregates (Gravel) ..	28	164
Stone Chips .....	27	160
Storage (of Material).....	6	37
Structural Plate Arch Culverts.....	66	396
Structural Plate Elliptical Culverts..	65	392
Structural Plate Stockpasses.....	66	396
Structures, Removal of Existing.....	40	244
Structures, Timber, Deck Waterproofing .....	43	275
Structures, Timber, Hardware.....	43	272
Structures, Timber, Material.....	43	272
Structures, Timber, Painting.....	43	275
Structure Excavation .....	45	280
Subletting of Contract.....	8	52
Supplemental Agreement .....	9	65
Supplementary Specifications .....	1	10
Surfacing Course—Crushed Base .....	24	147
Surfacing Course—Selected Borrow Base .....	23	143
Surfacing Course—Soil Cement.....	22	135
Surfacing Course—Plant Mix Bituminous .....	35	202
Surfacing Course—Road Mix Bituminous .....	34	194
Surfacing Course—Crushed Cover.....	27	160
Surfacing Course—Bituminous Surface Treatment .....	33	186
Surfacing Course—Sand .....	21	131
Surfacing Course—Seal Coat.....	36	216
Surfacing Course—Selected .....	21	130
Surfacing Course—Crushed Top.....	25	151
Surfacing, State Furnished Sources .....	6	34
Surplus Material, Disposal of.....	11	83
Suspension of Work.....	8	56
Syphons, Pipe .....	63	382
Tack Coat, Bituminous.....	32	182
Tax, Fuel, returns.....	7	48
Test Samples .....	6	36

	Section	Page
Timber Structures .....	43	272
Timber, Treated and Untreated.....	51	330
Timber Truss .....	43	276
Top Course Surfacing (See Surfacing Course)		
Topsoil .....	17	116
Traffic Provisions .....	16	110
Transite Sheets, Corrugated.....	53	276
Treatment, Timber Preservative, Incising .....	51	330
Treatment, Timber Preservative, Inspection .....	51	331
Treatment, Timber Preservative, Retention of .....	51	332
Treatment, Timber Preservative, Sampling and Tests.....	51	331
Treatment, Timber Preservative, Various Types .....	51	331
Unauthorized Work .....	9	66
Unauthorized and Defective Work, Removal of .....	5	30
Underdrains .....	70	410
Underdrains, Blind .....	70	410
Underdrains, Clay Pipe.....	70	410
Underdrains, Corrugated Metal.....	70	410
Underdrains, Perforated Metal.....	63	382
Use of Equipment.....	16	106
Walls, Retaining .....	44	278
Watering .....	15	101
Water for Concrete.....	39, 46	222, 293
Water for Soil Cement.....	22	135, 137
Water for Cover Material.....	15	102
Water Plant, Furnish and Maintain .....	15	102, 103
Waterproofing Bridge Decks.....	43	275
Weep Holes .....	46	314
Weighing, Marking and Shipping Structural Steel.....	42	263
Welds and Welding.....	42	259
Work, Control of.....	5	27
Work, Extra .....	4, 9	23, 65
Work, Extra, Payment for.....	9	65
Work, Failure to Complete on Time	8	59
Work, Force Account.....	9	65

---

	<b>Section</b>	<b>Page</b>
Work, Limitation of Operations.....	8	54
Work, Place of Starting.....	8	54
Work, Prosecution of.....	8	51, 56
Work, Scope of.....	4	22
Work, Special .....	4	22
Work, Starting of.....	8	56
Work, Suspension of.....	4, 8	24, 56
Work, Unauthorized .....	5, 9	30, 66
Work, Defective .....	5	30
Workmen and Equipment, Character of .....	8	52











ARTICLE 79.13, CONSTRUCTION METHODS

PARAGRAPH 'A' - GENERAL. The last sentence of the first paragraph shall be revised to read "A 'run' shall not exceed 990 feet on combination woven and barbed wire fence nor 1320 feet on barbed wire fence".

The fifth paragraph on Page 436 shall be amended by providing that when the specified Type is F-3 or F-4, construction shall be so performed that the bottom wire will not be closer than 13 inches, to, nor more than 18 inches from, the ground between posts.

PARAGRAPH 'D'. The last sentence shall be amended by deleting the words "----- and the top, middle, and bottom wire of the mesh -----".

PARAGRAPH 'E'. Shall be applicable to metal-mesh gates, when Type G-1 and G-2 gates are specified they shall conform to the provisions of Drawing No. 31.

PARAGRAPH 'F'. Shall be supplemented by providing that the post or brace hole shall be thoroughly wet when concrete is put in place.

Effective March 31, 1958

XX

SECTION 52, PILINGARTICLE 52.05, DRIVING, PARAGRAPH (a)

The formula for determining safe bearing value for piles driven by gravity hammers shall be amended to read as follows:

$$P = \frac{2WH}{S + 1.0}$$

Effective April 3, 1958

XX

SECTION 7, LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLICARTICLE 07.11, RESPONSIBILITY FOR DAMAGE CLAIMS

Shall be supplemented by the following provision.

The insurance carried by the contractor shall be endorsed to the effect that no policy shall be cancelled, altered, amended or coverage reduced, without the giving of not less than thirty (30) days' written notice by the Insurance Company to the insured and the Commission.

SECTION 14, ROLLINGARTICLE 14.02, EQUIPMENT REVISED 7/7/58

Amend the second sentence of Paragraph (b) to read as follows: - "Tamping feet shall be spaced not more than twelve (12) inches apart in a row parallel to the roller axis, nor shall the rows be more than twelve (12) inches apart, measured from center to center". The first sentence of the second paragraph shall be amended to provide that the load on each tamping foot shall be not less than three hundred (300) pounds per square inch of tamping foot area.

ARTICLE 14.03, CONSTRUCTION METHODS

Paragraph (b) shall be supplemented by the provision "Pneumatic-tired Rollers, as specified in Article 14.02, Paragraph (c), shall be used in addition to tamping rollers when directed by the Engineer". It shall also be supplemented by the provision that tamping rollers shall not be operated in tandem behind one power unit.

ARTICLE 14.04, METHOD OF MEASUREMENT DELETED 7/7/58

Supplement by providing that "effective rolling width" shall be defined as the distance from outside to outside of the faces of the feet which form a regular, symmetrical pattern. Odd feet inserted in the pattern, near the end of the drum, shall not be measured.

SECTION 34, BITUMINOUS SURFACING - ROAD MIXARTICLE 34.04, EQUIPMENT

Paragraph (a) Rollers, shall be amended to read as follows: - Rollers shall be the types specified in Paragraph (a) and (c), Article 14.02, Section 14, Rolling.

ARTICLE 34.04, CONSTRUCTION METHODS

The number of this article shall be changed to "34.05".

Paragraph (g) Spreading and Compacting:

The first paragraph shall be deleted and the following substituted therefor: After a satisfactory mixture, as determined by the engineer, has been obtained, it shall be spread, by a pneumatic-tired motor grader of the prescribed type, to the specified thickness. Rolling shall be carried on, throughout the lay-down operation, with the pneumatic-tired roller commencing with initial blade layout of the bituminous mixture and continuing until the mat is uniformly and thoroughly compacted and all roller marks are eliminated. Rolling shall proceed in a longitudinal direction, beginning at the outer edges and working toward the center or beginning on the low side, on super-elevated sections, and working upward. Each trip shall overlap the prior trip by about one-half the width of the rear roll. The pneumatic-tired roller shall be self-propelled and shall exert a minimum working pressure on the mat of two hundred and fifty (250) pounds per inch width of tire. Final rolling shall be done with the metal-wheeled roller. Roller operating speeds may be between 3 and 5 miles per hour but shall not be of such speed as to cause displacement of material. Any displacement shall be corrected immediately. The use of kerosene or diesel fuel to prevent pick-up on the finishing roller will not be allowed.

SECTION 9, MEASUREMENT AND PAYMENT

The last paragraph of Article 09.03 shall be revised to read as follows: Quantities of Class 'A' concrete and quantities of structure excavation will be increased, for bidding purposes, in the amounts (generally 5 per cent for concrete, and 15 per cent for excavation) shown on the plans. Roadway excavation quantities will be increased seven (7) per cent, unless especially provided otherwise, above computed quantities in order to cover possible overruns. Only accepted quantities actually entering into the final construction will be paid for.

SUBSECTION 16.30, TRAFFIC PROVISIONSARTICLE 16.31, DESCRIPTION

Shall be amended by changing the provisions of Schedules 1 and 2 to the following:

Schedule 1 - Requires the furnishing of two flagmen and necessary signals, signs, lights, and incidentals while work is in progress.

Schedule 2 - Requires the furnishing of two flagmen and necessary signals, signs, pilot vehicle with operator and signs, lights and incidentals while work is in progress.

Schedule 2 shall be in operation twenty-four continuous hours following the application of bituminous surface treatment or bituminous seal coat unless ordered otherwise, in writing, by the engineer.

ARTICLE 16.32, EQUIPMENT AND PERSONNEL

Paragraph (f) shall be amended by deleting the requirements that the flagman wear a "6-inch width red cloth band around the upper left arm". It is hereby provided, instead, that each flagman shall wear a bright red garment such as a shirt, vest, jacket, or coat and, in addition, shall wear red reflective headgear. It is further provided that a flagman shall be assigned no other duties during the time he is assigned to flag traffic.

ARTICLE 16.34, BASIS OF PAYMENT

Shall be amended by changing Item data to the following:

Item Number	Item Description	Unit
1631	Traffic Provisions - Schedule 1	Hour
1632	Traffic Provisions - Schedule 2	Hour

ARTICLE 16.33, METHOD OF MEASUREMENT

The second sentence shall be revised to read as follows: - When stipulated in the Proposal, Schedule 2 of Traffic Provisions will be measured by the hour for a combination of two flagmen and one pilot car.

SECTION 51, TREATED AND UNTREATED TIMBERARTICLE 51.04, TREATED TIMBER

The table at the top of Page 332 shall be supplemented to provide that fence posts shall be so treated as to have a minimum of 6 pounds, empty cell, retention of preservative per cubic foot of wood.

SUBSECTION 79.60, CHAIN LINK FENCEARTICLE 79.63, CONSTRUCTION METHODS

Paragraph 1, Posts, shall be amended to provide that holes in which concrete is to be placed for holding posts and braces shall be thoroughly wet before the concrete is poured in place.

ARTICLE 79.65, BASIS OF PAYMENT

The unit of measurement for Item Numbers 7961, 7962, 7963, and 7964, Chain Link Fence, shall be changed from "rod" to "foot".

SECTION 35, BITUMINOUS SURFACING - PLANT MIXARTICLE 35.03, MATERIALS

The first sentence of Paragraph (a) Aggregate shall be amended to read as follows: - The aggregate for Type I and Type II Plant Mix Surfacing shall conform to all the requirements for "Type 'A' Crushed Top Surfacing", Grading 2, unless specified otherwise in the proposal.

ARTICLE 35.05, PREPARATION OF AGGREGATE

The third sentence of Paragraph (1) shall be revised to read: - Aggregate for Type I Plant Mix Surfacing shall conform to the provisions of Article 35.03. The first sentence of Paragraph (2) shall be revised to read: - Aggregate for Type II Plant Mix Surfacing shall conform to the provisions of Article 35.03.

Effective April 22, 1958

SUBSECTION 22.30, SOIL CEMENT STABILIZATIONGENERAL

The term "Cover Material", such as used in Paragraph (5) of Article 22.32, Paragraph (6) of Article 22.36 and elsewhere, shall be changed to "Blotter Material". The Item Numbers and Descriptions set forth over the date of March 31, 1958 in these "Amendments to Standard Specifications" shall be revised to read as follows:

2245	Blotter Material	Cubic Yard
2246	Blotter Material	Ton

SECTION 27, CRUSHED COVER AGGREGATEARTICLE 27.07, BASIS OF PAYMENT

The Item numbers, Descriptions and Units, printed on Page 162, are to be considered a part of this Article. It shall be understood that when the Item Numbers and Descriptions set forth herein are used in a proposal, and in a resultant Contract, the material stipulated is to be supplied, produced, handled and applied, completed in place, under one Contract.

When the materials stipulated by this Section are to be placed in stockpile they will be listed under Section 28. When the materials are taken from stockpile and:

- Used for Bituminous Surface Treatment they will be listed under Section 33.
- Used for Seal Coat they will be listed under Section 36.
- The unit price bid under conditions (a) and (b) shall include loading, weighing, hauling and applying, complete in place.

The Provisions set forth herein shall supersede any conflicting provisions of Section 27.

SECTION 62, AGGREGATE BACKFILL FOR CULVERTS

(a) This Section shall be amended by changing the term "Aggregate Backfill" to "Gravel Backfill".

(b) The use and application shall be broadened to include any structure where such material may be required.

(c) The type of material that may be used for "Gravel Backfill" shall be interpreted to include sand which will be subject to approval by the Engineer.

(d) Item No. 6220, Sand Backfill, shall be deleted as a bid item.

(e) It is further provided that, even though "Gravel Backfill" is not shown on the Plans, such an item may be included in the Proposal as an arbitrary quantity for the purpose of providing a unit bid price for any quantity of "Gravel Backfill" that may be required during the course of construction. The quantity shown in the Proposal, under such a condition, shall not be guaranteed to be required or used and the Commission reserves the right to increase, decrease or omit all or any part of such item and no additional compensation will be allowed by reason thereof.

Effective May 22, 1958

XX

SECTION 2, PROPOSAL REQUIREMENTS AND CONDITIONSARTICLE 02.05, PROPOSAL GUARANTY

This Article shall be completely deleted and the following provision inserted in lieu thereof:

No proposal will be considered unless accompanied by a proposal guaranty, in an amount of at least five (5) per cent of the bid, made unconditionally payable to the State Highway Commission of Montana, which at the bidder's option may be cash, cashier's check, or certified check. Alteration of the proposal form as required to provide for the form of guaranty elected shall be allowed.

REV JULY 24, 1958







SUBSECTION 79.10, WIRE FENCEARTICLE 79.12, MATERIALS

PARAGRAPH 'H'. Metal Fence Posts and Braces, shall be amended by deleting the second sentence and adding the following provisions: When Type C-M fence is specified minimum lengths shall be as follows: - corner, end, gate and brace posts--7 feet 8 inches; line posts--7 feet; braces--7 feet 8 inches. When Types F-3-M, F-4-M or F-5-M fence is specified minimum lengths shall be as follows: - corner, end, gate and brace posts--7 feet; line posts--6 feet 6 inches; braces--7 feet. Brace panels may be composed of three posts, with two acting as braces securely bolted to the vertical member, all set in concrete. No more than three such panels shall be set in succession and such panels shall be no more than 330 feet apart.

PARAGRAPH 'I'. Wood Fence Posts and Braces, shall be amended by deleting the last sentence of the second paragraph and adding the following provisions: All posts which make up a corner, brace, gate or end panel shall be of the same specified size, excepting length. When Type C-W fence is specified minimum lengths shall be as follows: - corner, gate, brace, panel and end posts--7 feet 6 inches; line posts--7 feet; braces--8 feet 5 inches before cut to fit. When Type F-3-W, F-4-W or F-5-W fence is specified minimum lengths shall be as follows: corner, gate, brace, panel and end posts--7 feet; line posts--6 feet 6 inches; braces--8 feet 5 inches before cut to fit.

PARAGRAPH 'J'. Metal Gates, shall be supplemented by the following provision: Woven wire fabric conforming to Design 1047, Spec. No. 11, 6 inch stays, and in accordance with other applicable provisions of Paragraph 'H', Article 79.12, may be used as filler mesh for gates.

SECTION 90, GUARD RAIL AND GUIDE POSTSARTICLE 90.04, METHOD OF MEASUREMENT

The last paragraph shall be amended to read as follows: - Guard rail will be measured to the nearest lineal foot, along the face of the completed rail, from center to center of the end posts of each section. The terminal sections of steel beam guard rail will not be measured as such but shall be considered as necessary accessories, unless provided otherwise in special cases.

Effective June 13, 1958

XX

SECTION 14, ROLLERSARTICLE 14.02, EQUIPMENT

Paragraph (b), Tamping Rollers, shall be amended and revised to read as follows:

Tamping rollers shall consist of metal rollers, drums or shells surmounted by metal studs with tamping foot projecting not less than seven (7) inches from the surface of the roller, drum or shell. The wearing surface of each tamping foot shall have an area of not less than four not more than eight square inches. The weight of the roller shall be such that the pressure on the tamping foot wearing surfaces shall be not less than two hundred (200) pounds per square inch. Each and every tamping roller shall be subject to approval of the Engineer.

The amendment to this Article issued over the date of April 22, 1958, shall be rescinded.

ARTICLE 14.04, METHOD OF MEASUREMENT

The amendment to this Article issued over the date of April 22, 1958, shall be rescinded.

SECTION 79.10, WIRE FENCEARTICLE 79.12, MATERIALS

PARAGRAPH G. Metal Fence Stays, shall be amended to provide for page 9 1/2 wire instead of page 9.

PARAGRAPH H. Size of angle steel braces shall be changed to 2" x 2" x 3/16", or heavier. The base metal for angle posts and braces shall conform to either ASTM A 15, Intermediate Grade, or to ASTM A 16. Table SP-1, shown on Page 433, shall be deleted.

Metal line posts shall be of good commercial quality iron or steel and must be approved by the Laboratory prior to use. The anchor plate on metal line posts shall be so placed that the top edge will be approximately two feet above the bottom end of the post instead of plus or minus 2'3" as shown on Standard Drawing No. 34.

SECTION 90, GUARD RAIL AND GUIDE POSTSARTICLE 90.02, MATERIALS

Paragraph (1) (c) Metal Beam and Fittings. This shall be amended by the following provisions: The first sentence of the last paragraph shall be revised to read "Rail Units shall be given one shop coat before shipping when painted rail is specified." Add the following at the end: "When galvanized steel beam guard rail is specified, the rail units and terminal sections shall be galvanized in accordance with ASTM A 93 with a coating class of 2.50 ounces per square foot."

Paragraph (2) (a) Wood. This shall be amended and supplemented as follows: Hemlock shall be added to the type of wood allowed. Sawed posts shall meet the requirements for "Construction" grade posts and timbers as set forth in the rules of the West Coast Lumber Inspection Bureau or other equivalent grading rules. Guard rail and median barrier posts may be rough sawn or surfaced at the contractor's option; shapes and dimensions shall conform to current standard drawings. Posts shall be so nearly straight that the surface shall not vary more than one inch from a straight edge connecting the ends. The posts shall be seasoned in such a manner and to such an extent that the remaining moisture content will not interfere with the prescribed treatment. Posts for guard rail shall be treated with 5 per cent pentachlorophenol, using heavy petroleum solvent (0.40 lb. dry salts per cu. ft. of wood) and in accordance with Section 51. Treatment shall result in the darkest practicable color. The minimum depth of penetration shall be one-half (1/2) inch. Such posts shall not be painted unless specified. When subjected to testing as a simple beam with a 24-inch span and center loading applied to the back of the post, the posts shall withstand a load of not less than 30,000 pounds at failure. Round posts for steel beam guard rail shall conform to the following additional requirements:

- (1) Splits. Permitted only on bottom end of post and no longer than post diameter.
- (2) Peeling. All outer bark and at least 80% of inner bark shall be removed. The remaining inner bark shall be evenly distributed over the post surface and no strip shall be more than one-half inch in width.
- (3) Size. The minimum post diameter shall be between eight and nine and one-half inches (8" - 9 1/2"). The top or small end shall be trimmed, a hole bored for a guard rail bolt and the larger or bottom end sawed off square in conformance with the applicable Standard Drawing. To enable the use of standard bolts for a seven and one-half (net) inch post, the post shall be slab gined (flattened) by machine on the back side, if necessary, from top of post to a line two inches below the bolt hole, but the process shall not make the thickness at the bolt hole less than seven and one-half inches.

SECTION 90, GUARD RAIL AND GUIDE POSTS - ContinuedARTICLE 90.03, CONSTRUCTION METHODS

Paragraph (1) Posts. The next to the last paragraph shall be amended by removing the requirement for black paint in the case of pentachlorophenol treatment.

Paragraph (4) Metal Beams. The last paragraph shall be amended to read, "After erection, all abrasions on metal parts shall be spot painted, if painted beam guard rail is specified, with the first field coat of paint before final application of aluminum paint. All paints used shall conform to the provisions of Section 54. When galvanized guard rail or median barrier rail is specified, the finished sections, in place and completed, shall be free from bruised, broken, scaled or otherwise damaged spelter coating."

Article 90.03 shall be supplemented by the following:

Paragraph (5) Median Barrier Rail. Median Barrier Rail shall be constructed in accordance with applicable Standard Drawings. Median Barrier Rail is composed of the same specified elements which comprise steel beam guard rail, except that there is railing on each side of the post, presenting a barrier toward each roadway. The terminal section shall be specially designed for the purpose. Materials shall conform to Article 90.02. A galvanized metal washer, shaped to reasonably conform with the form of the metal railing, shall be used under the nut which goes on the threaded end. The design shown on Standard Drawing No. 13 MBR or a design that will be equally effective will be accepted. Construction methods shall be set forth in Article 90.03 and amendments. The type of rail and post shall be as specified.

ARTICLE 90.04, METHOD OF MEASUREMENT

Supplement by the following provision: Median Barrier Rail shall be measured the same as guard rail, with the length including both sides or beams.

ARTICLE 90.05, BASIS OF PAYMENT

The first sentence shall be amended to include Median Barrier Rail.

Item Numbers. The item number 9041 shall be used for painted steel beam guard rail with square treated posts.

Item numbers 9040 - 9044, incl. shall denote painted beam.

Item numbers 9046 - 9049, incl. shall denote galvanized beam.

These numbers shall be used as follows:

- 9046 Galvanized Steel Beam Guard Rail - Square Treated Wood Posts
- 9047 Galvanized Steel Beam Guard Rail - Concrete Posts
- 9048 Galvanized Steel Beam Guard Rail - Steel Posts
- 9049 Galvanized Steel Beam Guard Rail - Round Treated Wood Posts

The following shall be added:

- 9036 Painted Median Barrier Rail - Treated Wood Posts
- 9037 Painted Median Barrier Rail - Concrete Posts
- 9038 Galvanized Median Barrier Rail - Treated Wood Posts
- 9039 Galvanized Median Barrier Rail - Concrete Posts

SECTION 2, PROPOSAL REQUIREMENTS AND CONDITIONSARTICLE 02.06, PROPOSAL GUARANTY

This Article shall be completely deleted and the following provision inserted in lieu thereof:

No proposal will be considered unless accompanied by a proposal guaranty, in an amount of at least five (5) per cent of the bid, made unconditionally payable to the State Highway Commission of Montana, which at the bidder's option may be Cash, Cashier's or Certified Check, Postal, Bank or Express Money Order, or Bank Draft. Alteration of the proposal form as required to provide for the form of guaranty elected shall be allowed.

SECTION 23, SELECTED BORROW BASE COURSEARTICLE 23.02, MATERIAL

Amend by adding to the Table of Gradations:

- Grading 7, Crushed
- 100% passing 1" sieve
- 25-60% passing No. 4 sieve
- Less than 15% passing No. 200 sieve

ARTICLE 23.03

Add "Grading 7" to the materials covered herein.

ARTICLE 23.09

The following shall be added:

- Selected Borrow Base Course - Grade 7 - Cubic Yard - Item No. 2317
- Selected Borrow Base Course - Grade 7 - Ton - Item No. 2327

Effective July 24, 1958



